Design Engineering

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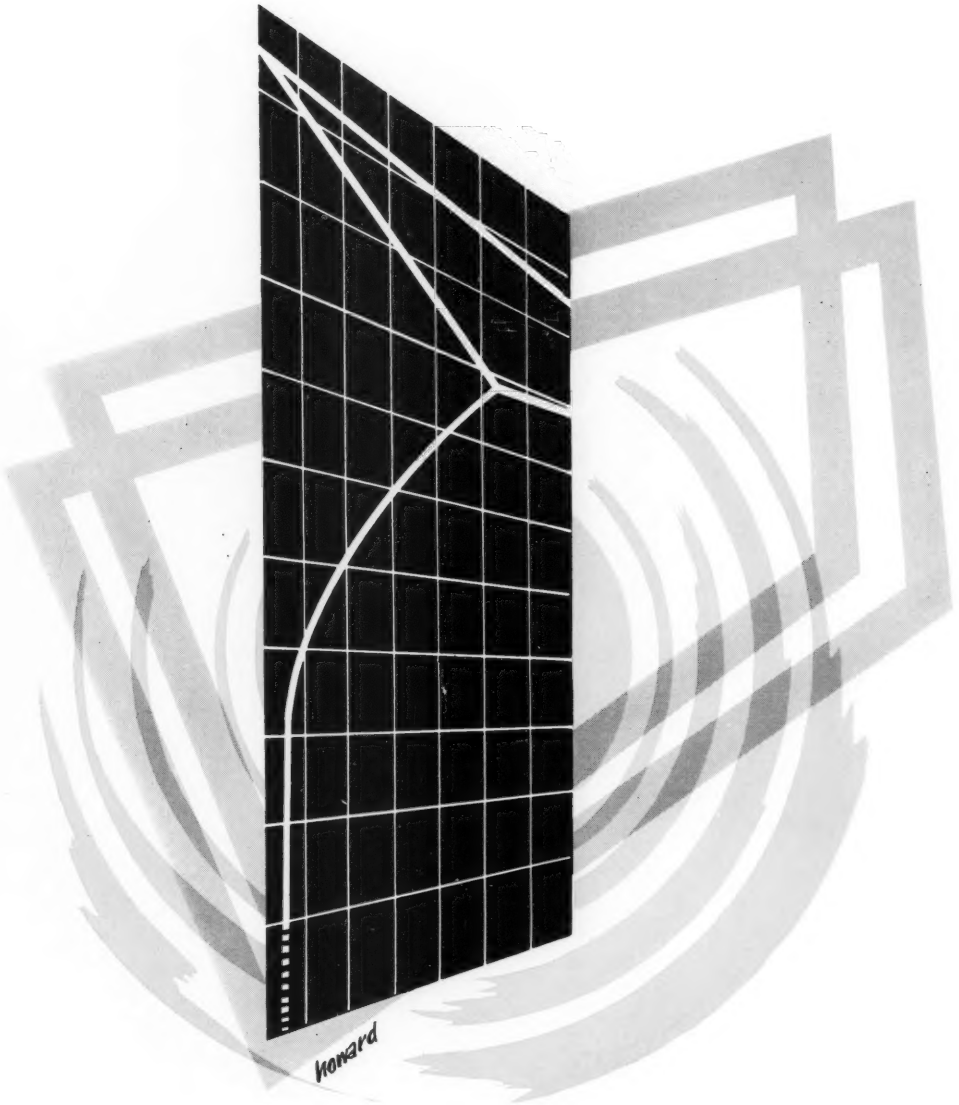

THE HEAT TREATMENT OF ALUMINUM (page 40)

Automatic de-icing gear, Canadian "first"
Enjar wheel is revolutionary design
Magnetic particles as your detective

November 1955

PUBLISHED BY MACLEAN-HUNTER PUBLISHING COMPANY, LIMITED, TORONTO, CANADA

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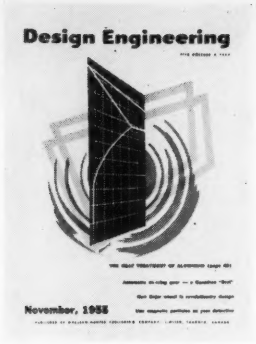

Design Engineering

VOLUME 1 **NOVEMBER, 1955** NUMBER 8

This month's cover

Artist Harry Howard produced the striking cover for this month that illustrates the heat treatment of aluminum. The black and white grid shows in part the equilibrium diagram for aluminum-copper alloys. The two light colored rectangles illustrate the movement of crystals in the metal on their slip planes.

Design Engineering

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Inside

The December issue of **Design Engineering** will carry strong feature articles written by contributors no iess experienced than those featured this month.

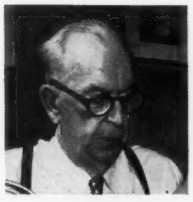
Photoelasticity, our cover feature for December deals with photoelastic techniques without delving too deeply into theory.

Magnetic Memories tells of new tape recorders, producing the ultimate in sound reproduction, to the accurate reporting of guided missile data.

Special Artwork
Editorial layouts designed by art consultant Desmond English.

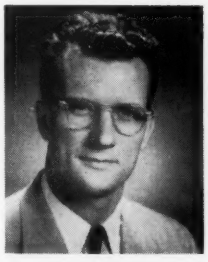
Whiting

A WRITER OF technical handbooks in the publications division of Aluminum Laboratories, Kingston, **Howard F. Whiting** was contributor of the story on the heat treatment of aluminum, page 41. A metallurgical engineering graduate of Queen's University in 1941, he worked for seven years on the technical staff of the company dealing with the problems in heat treatment. Active in church work, he is fond of woodworking and sports.



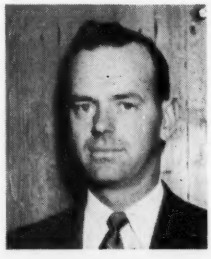
Maclean

HOW LONG CAN one man persevere on an idea. **James M. Maclean** battened himself to the Enjar wheel invention for 30 years. He believed there was a future for the untapped resilient wheel despite the failures of any other experiments. Inventor Maclean did not write the Enjar wheel story (page 29), Design Engineering editors prepared it, but with his most generous help. The magazine here makes a low editorial bow to a very determined Canadian.



Bridgman

IN CHARGE OF all air-borne radar in the Middle East during World War II, **J. M. (Monty) Bridgman,** author of the automatic ice detector story, page 47, became an RCAF officer in Ottawa following the war. There he headed the Shoran radar survey project until 1946 when he began a one-man technical division for PSC. A growing acceptance of products and services of Photographic Survey Corp. led to the formation of PSC Applied Research of which he is managing director.



Baxter

AFTER SERVICE IN the RCAF from 1940-45, **Leonard E. Baxter,** 35, completed his education at Sir George Williams College, where he graduated from the Faculty of Science in 1947. That same year he was made manager of the welding and inspection department of Williams and Wilson Ltd., Toronto. He still retains an affiliation with flying as a member of the Air Force Association Toastmaster Club. Golf, photography and bridge occupy less busy hours.

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AGENTS THROUGHOUT THE WORLD

Reports

News in brief from the world's producers

TORONTO — Three aircraft companies here have begun an advanced educational program in conjunction with the Institute of Aerophysics, Toronto University.

The program, company sponsored by **Avro Canada**, **Orenda Engines** and **de Havilland Canada,** has a curriculum designed to encourage aeronautical engineers in Canada to proceed to higher degrees.

Candidates, in order to qualify, must hold a Bachelor Degree in aeronautical engineering that is recognized as satisfactory by the university School of Graduate Studies.

D. J. Tynan-Byrd, Avro's educational supervisor told Design Engineering that his company has received nearly fifty applications of which he expected twelve would be selected.

Orenda Engines are sending two and de Havilland have accepted nine for the course, which will be paid for by each company.

Leading to M.A.Sc., the course lets the engineer work during the first year and attend lectures on Wednesday evenings and Saturday mornings. The mid-week lectures deal with the minor subject, a seminar on Aircraft Design. Saturday, the major subject, Advance Applied Aerodynamics will be covered.

During the second year, the engineer will spend seven months at university to complete his degree. Throughout this period he will be paid a proportion of his salary. Married men will receive three quarters of their pay and the single men will get one half.

Both the U. S. and the U. K. have had similar programs where companies sponsored graduates at some universities, but the idea is relatively new to Canada. Closest approach in the past has been the Avro plan of sending two men a year to the Cranfield School of Aeronautics run by the British government. One engineer returned to the company in July, two are on their second year and two more have just begun the two-year curriculum.

It has been evident that Canada has lacked seasoned aeronautical engineers — hence the practice of going outside the country for many personnel.

Canada's aircraft industry is growing; Canada's supply of aeronautical engineers is growing. But what is happening in other industries? Key level executives are taking note of the co-operation between the aircraft industry, the engineer and the educational media. And they are following their lead. The outcome of this liaison is giving Canada improved engineers.

• • •

MONTREAL — Canada's role in North American defense production is a critical one, and its impetus has been added to with a large order for Sabre jet aircraft placed by the United States Airforce with Canadair.

As a result, the Sperry Gyroscope Company of Canada here has been awarded a contract for fire control equipment valued at $1,300,000, originating with the USAF. The gunsight equipment will be used on the Sabres.

The equipment is the same as that made by the parent Sperry firm in the U. S. — equipment credited by pilots with overwhelming victories over the MIG's in Korea. It will be made and assembled in Sperry's Montreal plant that was purchased from the Dominion Government last April. The company originally built the plant for the manufacture of aircraft and marine instruments for the Dept. of Defence Production in World War II.

Swiss and German immigrants, who comprise a substantial percentage of the company staff, are applying their watchmaking skills to the building of the precision control equipment.

• • •

A CONTRACT has been awarded to the **Lummus Co. (Canada) Ltd.** by the Quebec Ammonia Co. Ltd. It is for the design and construction of a plant for producing 125 tons per day of anhydrous ammonia and nitrogen solutions.

The plant is expected to be in operation in about 12 months.

• • •

TORONTO — Private and executive flying by jet was projected into closer reality here in mid-September — or was it?

A DESIGN ENGINEERING editor who flew in the Morane-Saulnier 760, French-made twin-jet was thrilled and impressed. So were other members of the press who had a flight in the first and only jet aircraft in the four-place field.

What then were the reactions of the flying executive, since it is his opinion that will or will not foster orders for the MS 760, which is slated for manufacture by **Beechcraft.**

John David Eaton, department store head and a pioneer in Canadian executive flight, says the French jet is too small for practical executive use.

Were speed, absence of noise and fine appointments the major factors in executive flight, air-minded Eaton did not hesitate to endorse the MS 760. But space in the new jet does not constitute executive requirements, he added.

"I was only up a few minutes on a test flight . . . but from what I could see there is only room for a tooth brush . . . that's not practical on a flight to Vancouver for instance," executive Eaton mused.

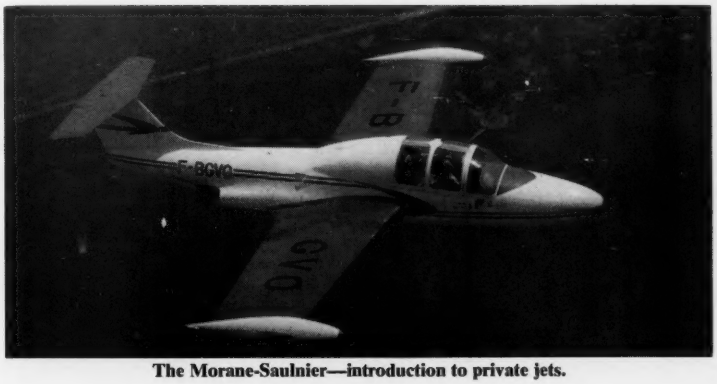
At present, the big Eaton DC-3 transports company executives to points all over Canada.

DESIGN ENGINEERING would be inclined to agree with businessman Eaton as to the limits of space, but would point out that the MS 760 does comfortably carry three passengers plus pilot and reasonable luggage. It can easily make nonstop flights between Toronto-Montreal or Toronto-Windsor and its maximum range is over a thousand miles.

Not every Canadian or U. S. executive flies on the scale or with the retinue as air-conscious Eaton. On the other hand few companies would be able to run the aircraft efficiently unless they were big.

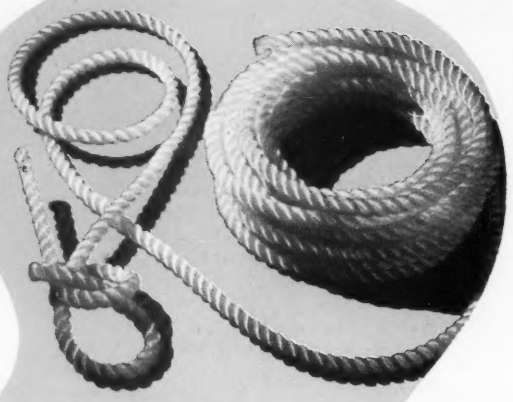
Although a Beechcraft spokesman said no price had been put on the aircraft, rumors of $300,000 have been prevalent. Undoubtedly it will be both expensive to buy and to operate.

But there should be a market! And if the demonstration flights prove to be the success they were to September 14, then the 410 mph silvery streak will be in regular production.

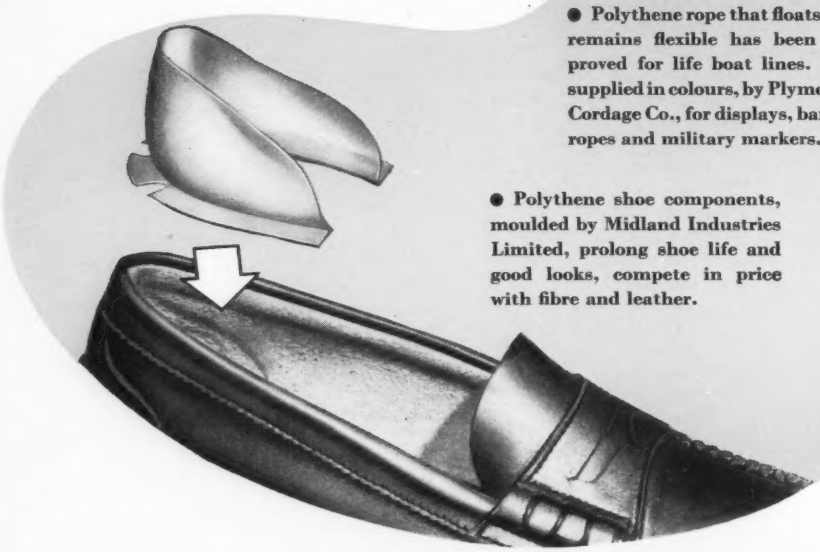


The Morane-Saulnier—introduction to private jets.

Now they're making rope and shoe parts of flexible polythene



● Polythene rope that floats and remains flexible has been approved for life boat lines. Also supplied in colours, by Plymouth Cordage Co., for displays, barrier ropes and military markers.



● Polythene shoe components, moulded by Midland Industries Limited, prolong shoe life and good looks, compete in price with fibre and leather.

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Look for new products, new developments in the pages of the C-I-L "Plastics Sphere".

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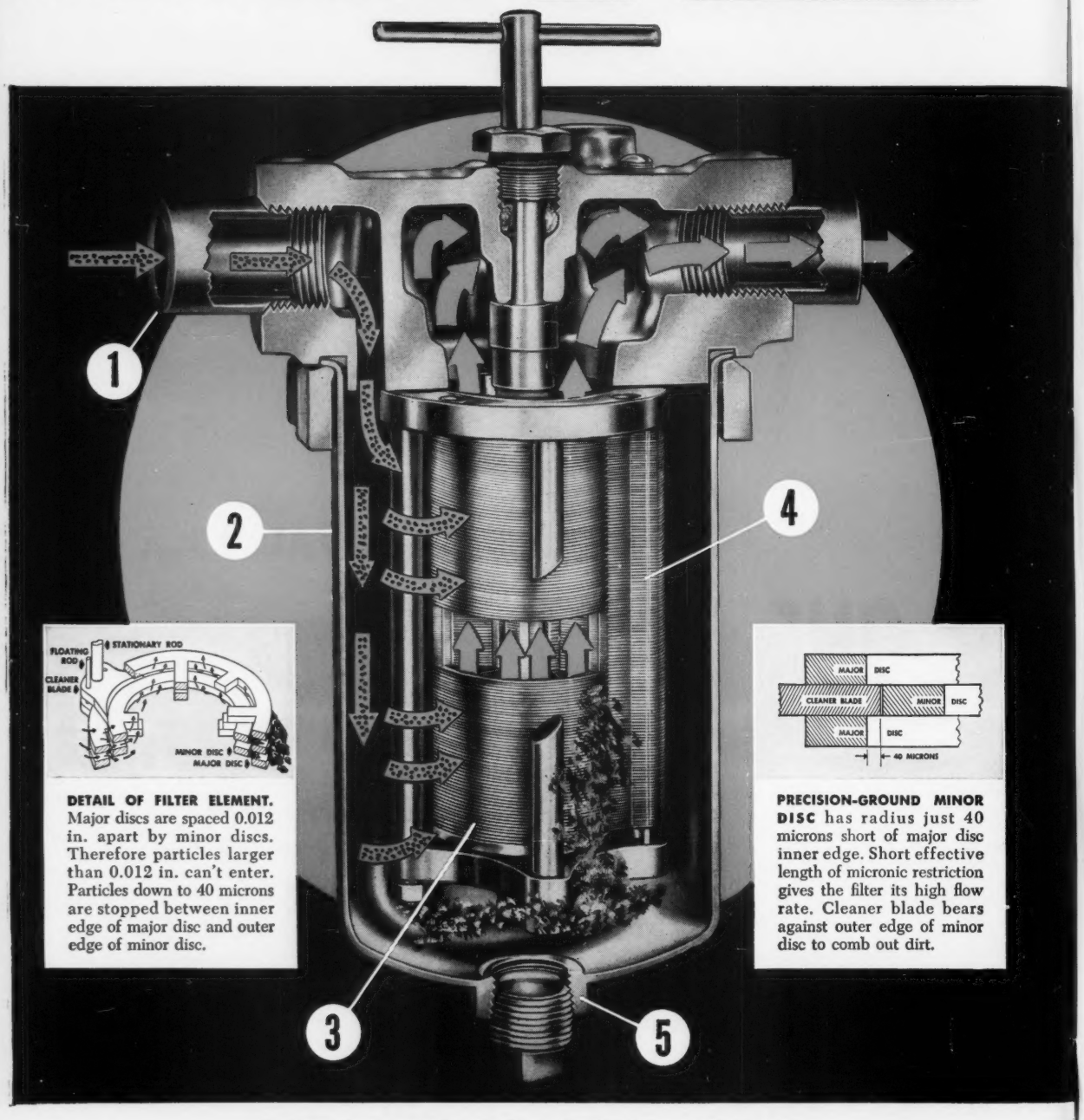


DETAIL OF FILTER ELEMENT. Major discs are spaced 0.012 in. apart by minor discs. Therefore particles larger than 0.012 in. can't enter. Particles down to 40 microns are stopped between inner edge of major disc and outer edge of minor disc.

PRECISION-GROUND MINOR DISC has radius just 40 microns short of major disc inner edge. Short effective length of micronic restriction gives the filter its high flow rate. Cleaner blade bears against outer edge of minor disc to comb out dirt.

CUTAWAY of new SUPER Auto-Klean. Dirty liquid enters inlet (1) at left, fills housing (2) and flows through metal-edge filter (3) of stacked major and minor discs. Trapped dirt is combed out by cleaner blades (4) when discs are rotated and is removed through drain (5). Clean liquid rises through center of filter element, leaves at right.

self-cleaning filter!

The SUPER Auto-Klean for lube, hydraulic fluid, coolant, fuel and other liquids

. . . and you can clean this filter by simply turning the handle!

Many times smaller than other micronic filters of equal capacity, Cuno's new SUPER Auto-Klean filter now makes possible economical, compact, micronic filtration at high flow rates and eliminates the need for replacement cartridges. On machine tools and industrial machinery, SUPER Auto-Klean gives micronic filtration of lubricating oil, hydraulic fluids, coolants, fuels and other liquids. Here's what it offers:

1. Full-flow micronic filtering with a self-cleaning filter. Filter can be cleaned continuously with motor drive or intermittently by manually turning handle.

2. Eliminates cartridge changes. Ends operating costs if you've been using cartridge filters.

3. No pressure drop build-up. An 8-in. long, 2½-in. diameter cartridge handles 30 gpm of oil of 200 SSU viscosity with only 3 psi pressure drop—up to 75% more with slightly higher pressure drop.

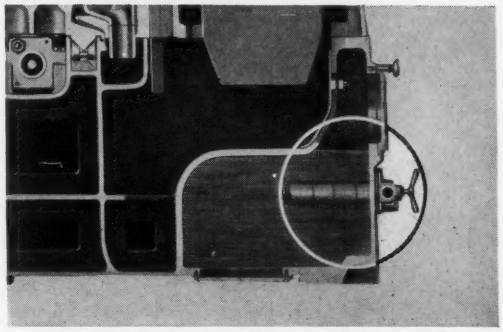
4. Positive protection against particles larger than 40 microns (actually 0.0015 in.). Filter can't rupture or channel.

5. Much smaller than replaceable-cartridge-type filters of equal capacity. It saves with lower initial costs, lower installation costs, requires less space than cartridge units. You get high capacity in a small package.

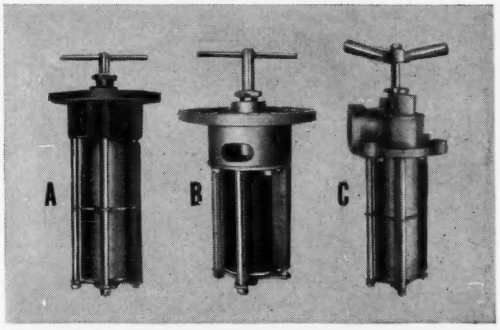
6. No duplex units needed. Handles full flow all the time with no interruptions for cleaning.

7. SUPER Auto-Klean fits existing Auto-Klean housings. You can easily replace most 2¾-in. diameter cartridges with SUPER Auto-Klean for finer filtration.

Send coupon for complete information on the new SUPER Auto-Klean filter, for your new designs or existing equipment. Peacock Brothers Limited, P.O. Box 1040, Montreal 3, Que.



WILL IT FIT? Here's how one designer answered that question. Filter *(circled)* mounts horizontally in side wall of hydraulic fluid reservoir in this surface grinder.



FILTERS FOR INTERNAL PIPING *(A and B above)* allow streamlined design plus the best in filtration. Flange mounting with external outlet *(C above)* and line-type *(cutaway on facing page)* are just two of many other possibilities.

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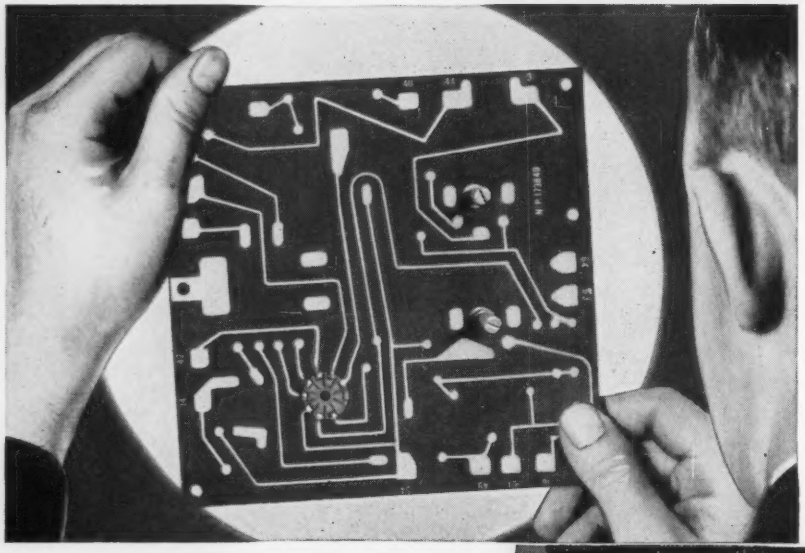
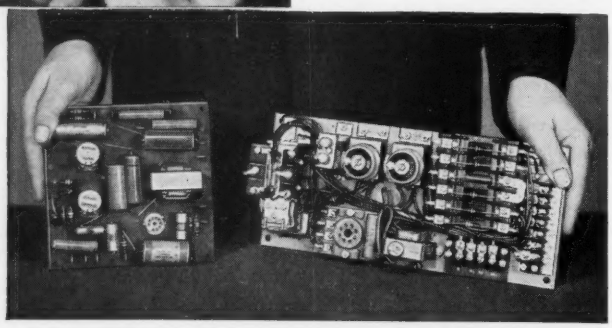
C.G.E. Announces New Low-price Thy-Mo-Trol* Drive with Printed Control Circuit...



Shown here is the "brain" of the new general purpose G-E Thy-Mo-Trol Drives. Here an electrical diagram, or electrical "track", is printed on the back of a sturdy plastic board. This "track" consists of solder-covered copper strips which connect all circuit components without the use of wiring.

NOW! GET RELIABLE, SMOOTH, ADJUSTABLE SPEED FOR MACHINE TOOLS IN A SIMPLIFIED LOW-PRICED DESIGN!



Here is ample evidence of the simplicity and reduced size made possible by the new G-E printed control circuit system, left. At the right is the conventional type. Note its larger size and complexity.

By adapting printed or "wireless" circuits to a completely new line of G-E Thy-Mo-Trol Drives, C.G.E. offers industry electronic adjustable speed drives at up to 20% reduction in cost.

These drives consist of an electronic control panel, a DC motor, and a push-button station. The big price difference is made possible by the use of printed circuits in the control panel. Designed for quality performance, reliability and easy maintenance, these G-E Thy-Mo-Trol drives are available in two ratings: ¾ to 1 hp and 1½ to 3 hp. They feature reductions in weight, size, circuit complexity, wiring, and maintenance and installation costs. They supply constant torque over the entire speed range, which is 8 to 1, with higher ranges possible for special applications.

For further information on these outstanding new low-cost drives, contact your nearest C-G-E office or write to: Apparatus Department, Canadian General Electric Co. Ltd., 212 King St. West, Toronto, Ont.

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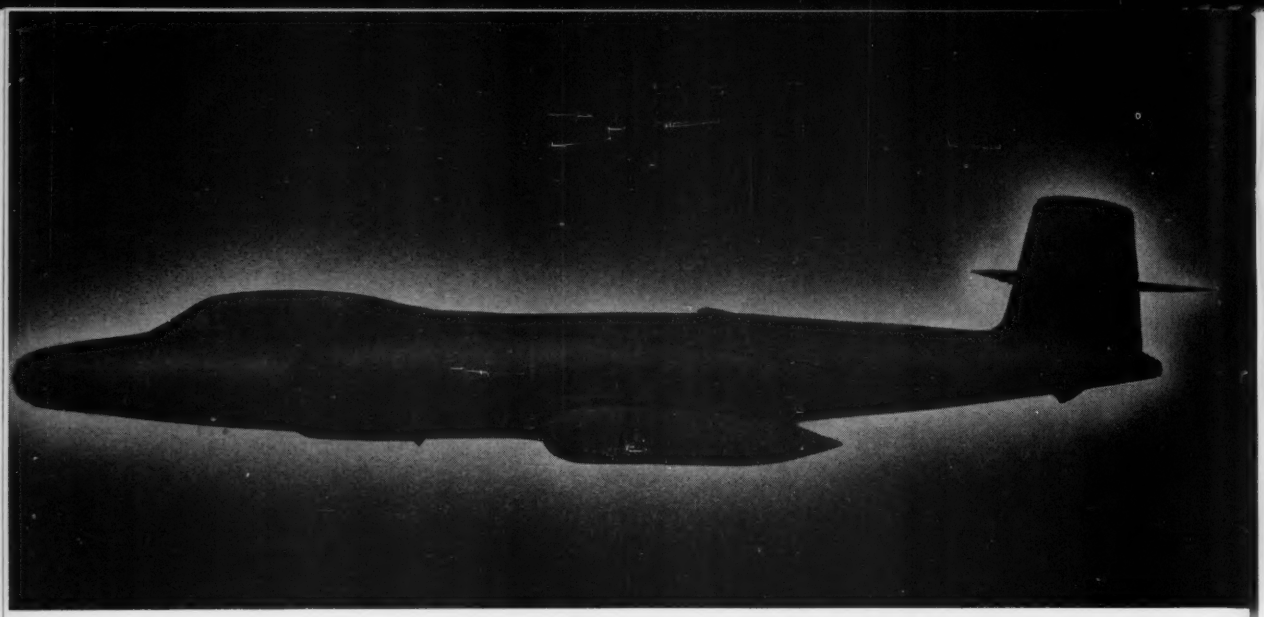

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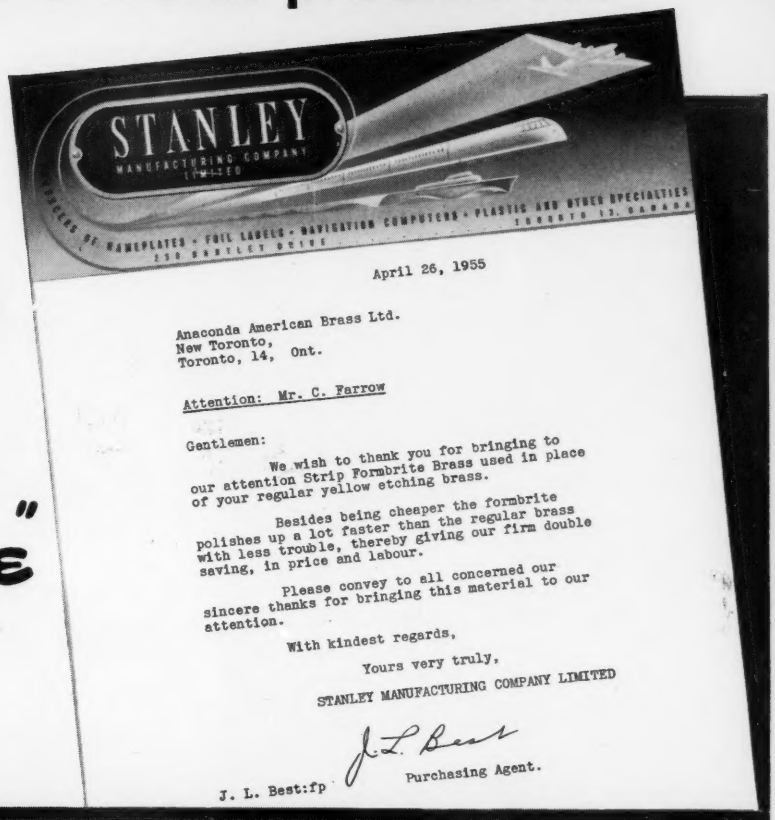

April 26, 1955

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With kindest regards,

Yours very truly,

STANLEY MANUFACTURING COMPANY LIMITED

J. L. Best

J. L. Best:fp

Purchasing Agent.

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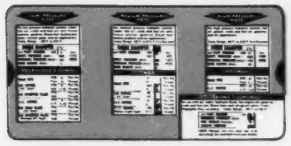

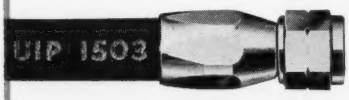

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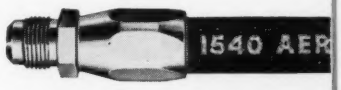
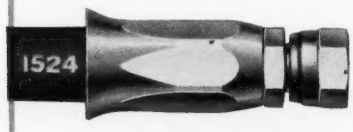
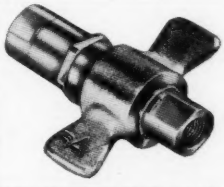
AEROQUIP FREON HOSE for use on automotive and commercial air conditioning units and refrigeration equipment using Freon 12. In sizes from ¼" to 2"; for pressures up to 300 p.s.i.; temperature range —20°F. to +170° F





AEROQUIP 1524 BURST-PROOF STEAM HOSE with ***"little gem"*** fittings for steam cleaning units, dry cleaning and pressing equipment, foundry equipment, plastic molding presses, rubber curing and vulcanizing equipment. Sizes ½" to 1"; for pressures up to 200 p.s.i. (388°F.). With or without oil resistant cover.



AEROQUIP SELF-SEALING COUPLINGS allow quick separation and reconnection of fluid lines without loss of fluid or inclusion of air into the system. Replaces two shut-off valves. In sizes from ⅛" to 1½"; for pressures up to 2000 p.s.i.; temperature range —40°F. to +250°F.

SOCKETLESS **and** ***"little gem"*** **are Aeroquip trademarks**

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Aeroquip

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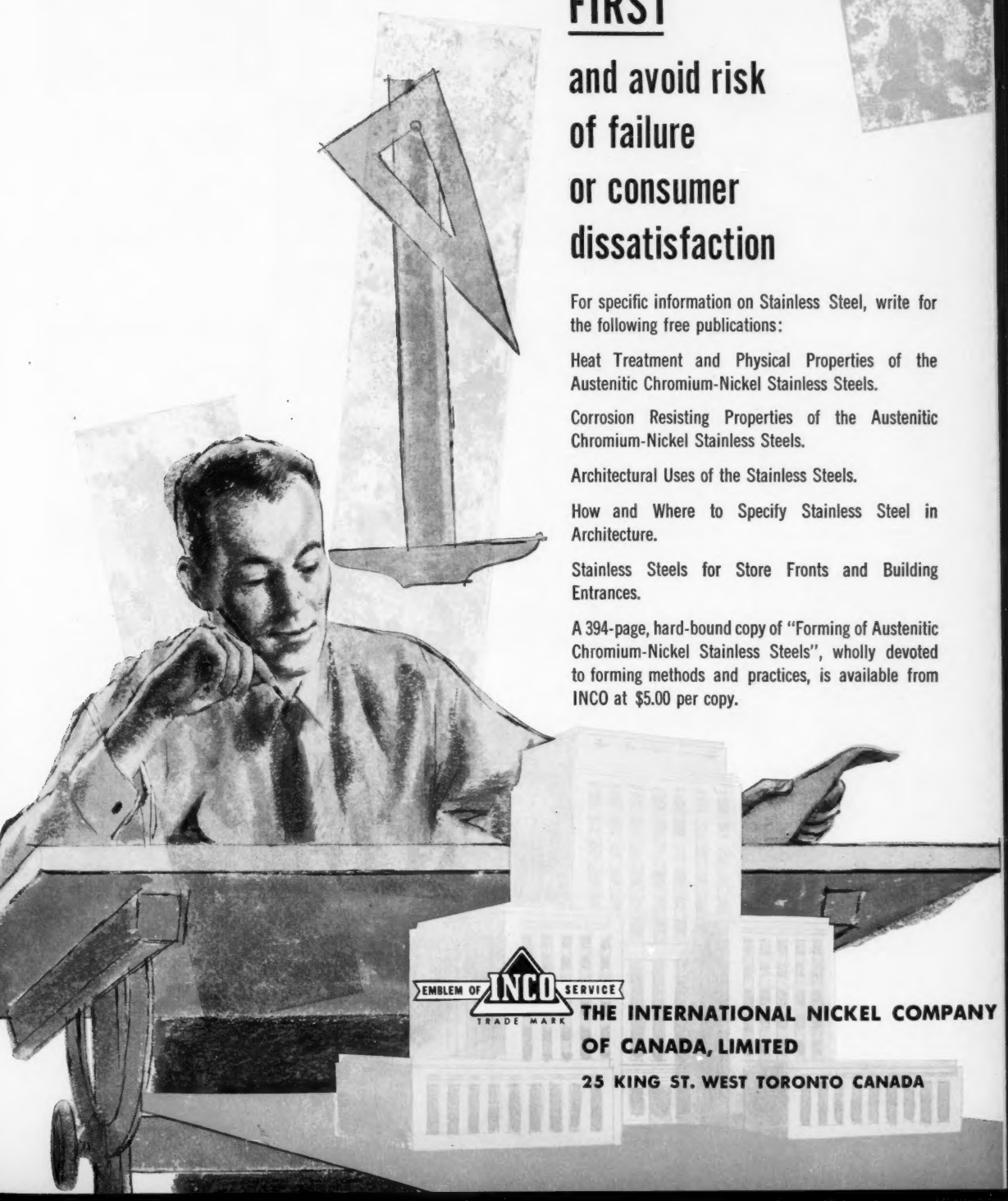
Stainless Steels for Store Fronts and Building Entrances.

A 394-page, hard-bound copy of "Forming of Austenitic Chromium-Nickel Stainless Steels", wholly devoted to forming methods and practices, is available from INCO at $5.00 per copy.



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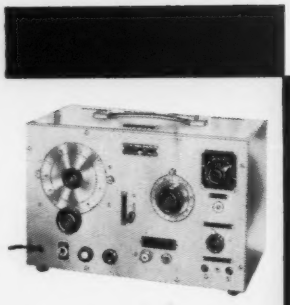
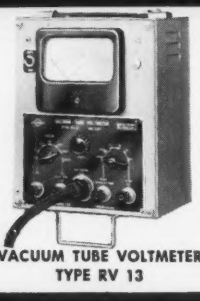
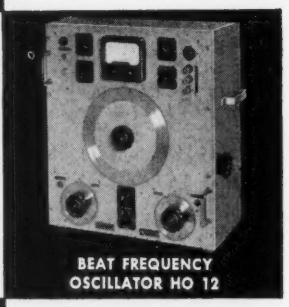


SIGNAL GENERATOR
MS 25

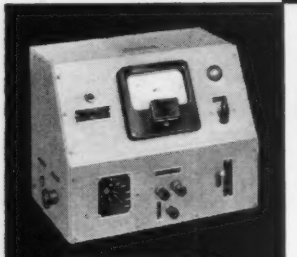
NOISE GENERATOR
TYPE DSG 1



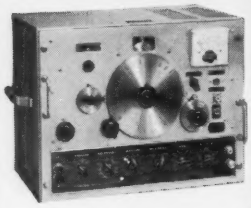
VACUUM TUBE VOLTMETER
TYPE RV 13



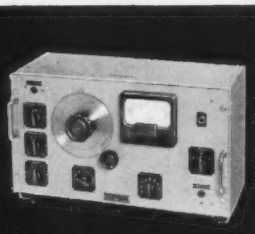
BEAT FREQUENCY
OSCILLATOR HO 12



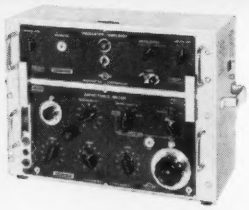
LIMIT BRIDGE TRB 1



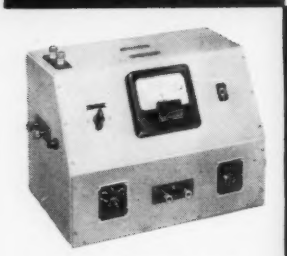
AM STANDARD SIGNAL
GENERATOR TYPE MS 15



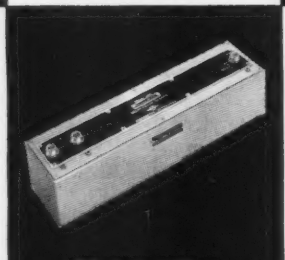
DISTORTION METER BKF 5



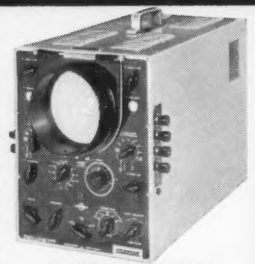
CAPACITANCE BRIDGE
TYPE CMB 1



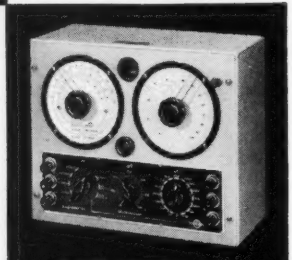
MEGOHMMETER 1 M 3



DELAY LINE KL 41



OSCILLISCOPE OSG 41



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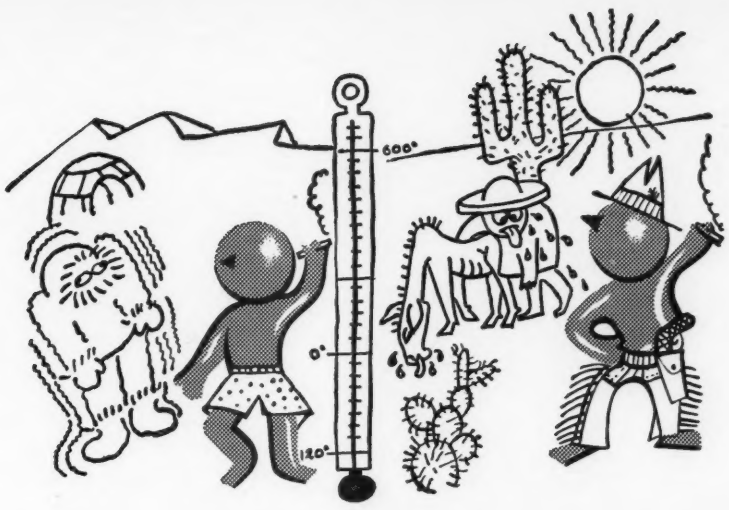

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In paints and electrical varnishes, G-E Silicone Resins will not flake, discolor or decompose at extremely high temperatures. On exhaust stacks, appliances, furnaces and heaters, colored finishes stand up to 600°F, aluminum finishes up to 1000°F.

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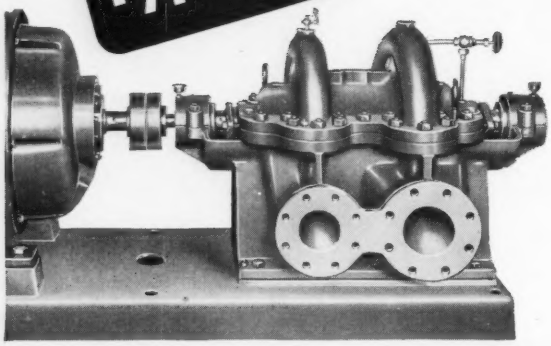
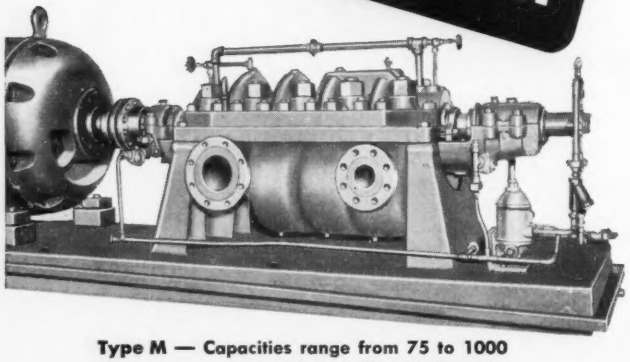


Type CM — Available in sizes from 75 to 5000 gpm at heads up to 800 ft. for temperatures up to 250°F. Low initial cost.

Type M



Type M — Capacities range from 75 to 1000 gpm or more at heads from 400 to 2100 ft. for temperatures up to 400°F. Optional features include water-cooled stuffing boxes, ring oiled ball bearings with water jacketed housing, forced oil lubrication with cooler, ball, sleeve or Kingsbury bearings.

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- **Double-suction impellers eliminate end thrust and sudden shock load from flashing. No special balancing device necessary.**
- **Horizontally split casing permits easy maintenance to rotating element without disturbing piping or motor.**
- **Stuffing box pressure equalized — reduces wear on shaft, sleeve and packing.**
- **Mechanical seals and smothering glands optional.**

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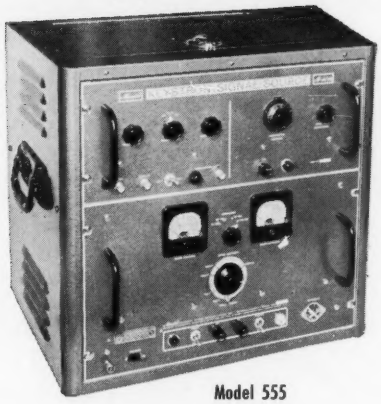

Model 555

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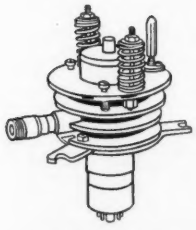
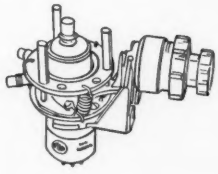
Model 555 is a stable generator of either modulated or unmodulated d-c power for the operation of Klystron tubes. It is useful for powering bench oscillators in measurement and development laboratories and in testing production controls. It is also applicable as a local oscillator for special purpose receivers in microwave receiving systems. The internal modulator provides sine, sawtooth or square-wave signals, adjustable in amplitude. Optimum operation under all loads is automatic without adjustment. Beam supply -250 to -3600 volts, 0 to 120 ma up to 1250 v, and 0 to 15 ma from 1250 to 3600 v; Reflector supply 0 to -1000 volts; Control-electrode supply 0 to -300 volts; Klystron Heater supply 6.3 volts, 2 amps.

*Registered

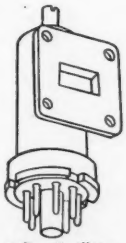


Reflex Oscillator
Klystron SRL-7 series

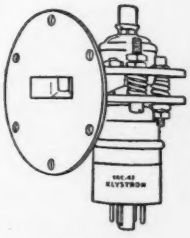
Reflex Oscillator
Klystron 5981/5650



Reflex Oscillator
Klystron 2K41



Reflex Oscillator
Klystron SRU-55



Reflex Oscillator
Klystron SRC-43 series

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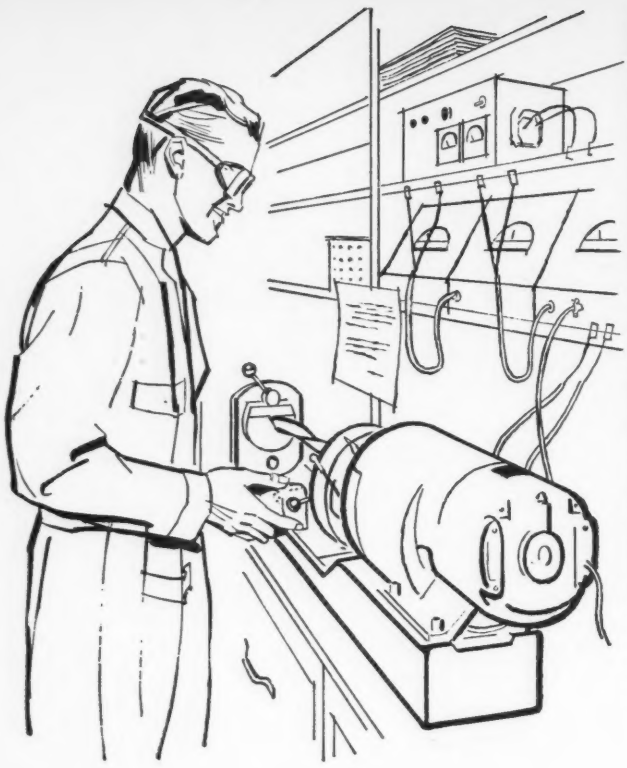
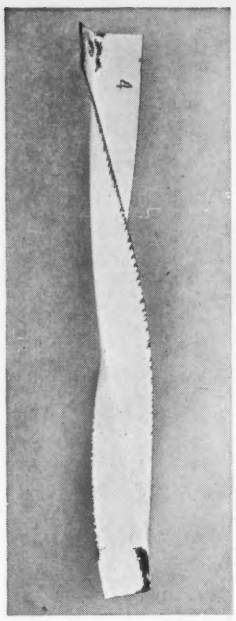
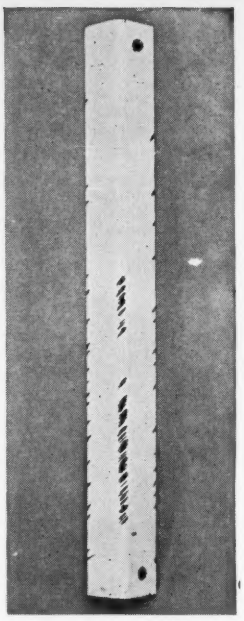




Enameling iron, with 1 coat of porcelain enamel over Parker Pre-Namel 410, was twisted 255° before enamel fractured.



Enameling iron, with conventional 2-coat system of porcelain enamel, fractured badly when twisted only 70°. (Twisted less than its elastic limit, metal returned to its original shape).

NEWS OF A REVOLUTION
in porcelain enameling

Porcelain enameling on steel has always been a preferred finish. However, its use has been limited by cost and by difficulties in the processing.

Now, a big change is about to take place.

Parker Rust Proof Company's research has discovered and developed a surface treatment for steel which permits the application of the porcelain enamel finish coat directly to ferrous metals, reduces cost, improves quality and eliminates many production difficulties in porcelain enameling. Pilot runs and production tests have shown that the new Parker process is effective and practical.

The new treatment, making use of Parker Pre-Namel 410, has been shown to simplify porcelain enameling, achieve high quality uniform results, reduce use of frit, produce a more durable finish. Savings of from 1 to 3 cents per square foot of enameling surface are indicated.

Now, with Parker Pre-Namel, porcelain enameling may be used more widely, bringing the advantages of this superior finish to more and more products.

Write for full information.

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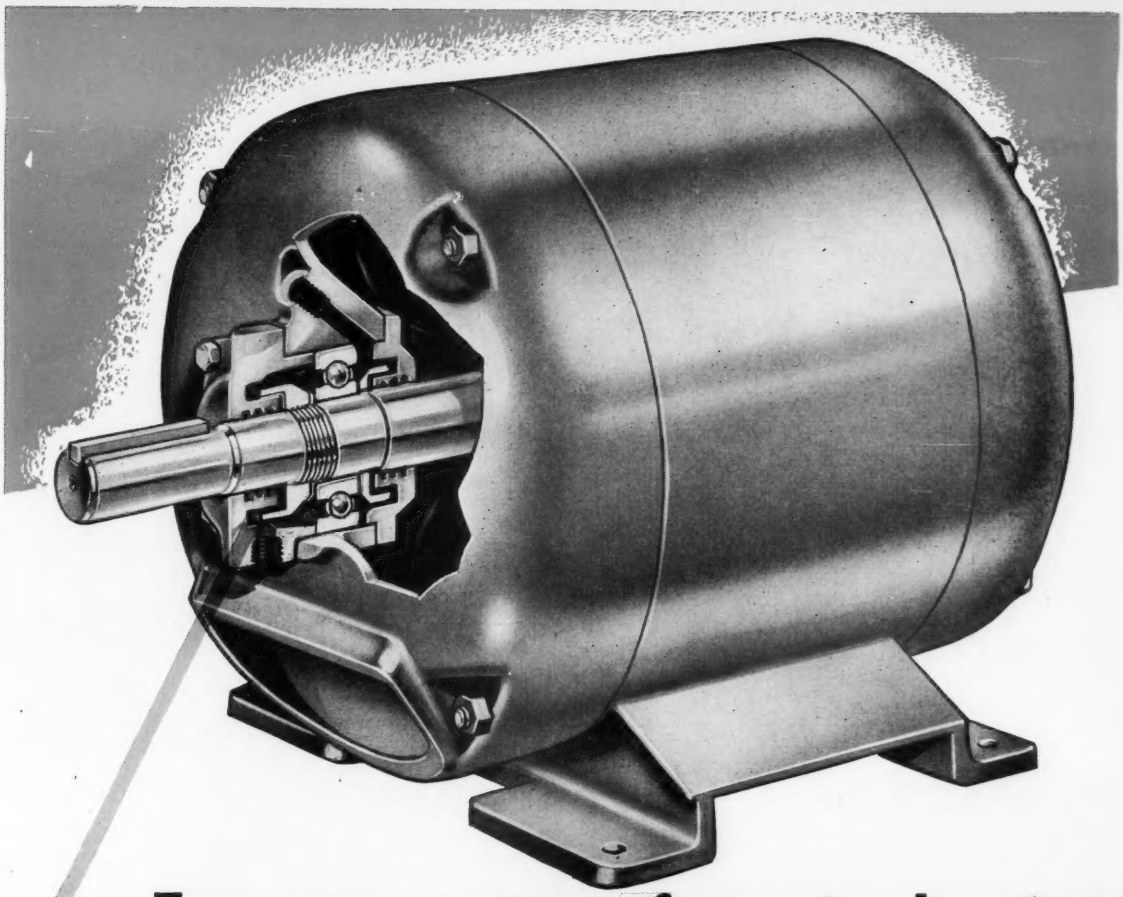

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... assures efficient, "clean" lubrication

● Where Maintenance Engineers deem it advisable to lubricate ball bearing motors, Wagner has built in a Transverse System of greasing that automatically displaces all the old grease and leaves only fresh, clean, bearing lubricant. This is a feature exclusive to Wagner Motors that adds years of trouble-free operation.

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For "cold room" or "hot spot" installations, you can depend on Wagner.

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... use Torrington's
"S Series" fan blade

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The "S Series" fan blade represents only a small portion of the unusually broad variety of air impellers which Torrington produces for heating, ventilating, refrigerating and air conditioning equipment. This product range and manufacturing capacity can provide ... quickly and at low cost ... the fan blade or blower wheel best suited to your air-moving requirements. Torrington has extensive research and test facilities which are available to assist you in the solution of design problems relating to air flow, sound and vibration.
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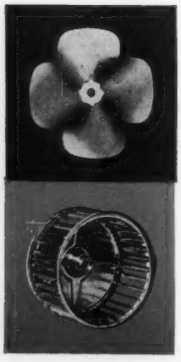

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VIP's

Important people who are in the news

ELSIE GREGORY MACGILL of Toronto is the only woman in Canada who is a consulting aeronautical engineer. Her work has been so well recognized that she was named "Woman Engineer of the Year" in 1953 by the Society of Women Engineers. She is the first Canadian to receive the international honor given in recognition of her meritorious contribution to aeronautical engineering. Her wartime work for the British government went on record as "outstanding."

A graduate of the Faculty of Applied

STAR PICTURE

ELSIE MACGILL

only woman aeronautical consultant

Science and Engineering at Toronto University in 1927, Consultant MacGill did postgraduate work in Michigan.

Author of newly released book titled "My Mother—The Judge," she tells in it about her mother's career as first woman on the bench in British Columbia.

Elected president of the Business and Professional Women's Clubs of Ontario at the provincial conference in October, she will assume office in June, 1956.

• • •

FORMER USAF CAPTAIN, **Bruce F. Smith** is Dow Corning Silicones manager in the Canadian company's new Montreal office.

Manager Smith, who graduated in 1949 in chemical engineering from Michigan State, spent six years with the parent Dow in the U. S.; four in the company's export sales where he was manager of technical service at the time of his transfer, and two years in the product engineering laboratory.

The growing use of silicones in Canada shows up in Bruce Smith's posting to Canada, since his move will broaden Dow service to users in the Montreal area.

• • •

"PETROLEUM INDUSTRIES face a safe future despite advances in atomic power," observes **L. Earl Colburn,** technical sales manager for the newly formed Calgary firm of Poole-Pritchard Ltd.

"As use of atomic energy grows," he told DESIGN ENGINEERING, "present fuels will probably be used to a greater extent in the manufacture of chemicals."

The new company, uniting Poole Construction, Edmonton and F. Pritchard, Kansas City, Missouri, where he was formerly employed, has been organized to offer engineering and construction services to natural gas, petroleum, chemical and power industries in the Canadian west.

Kansas City (Missouri) born and educated, manager Colburn was a chemical engineering graduate of Kansas University in 1940.

Before World War II he worked for Du Pont and Seagrams. During naval service he spent three years as an air ordnance officer.

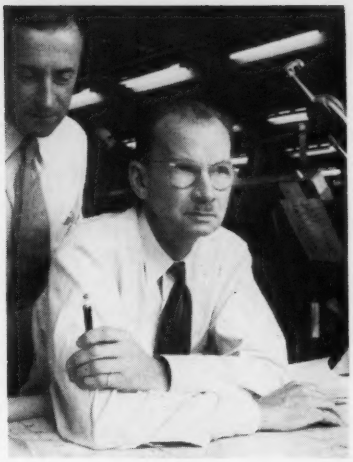
He lives in Calgary with his attractive wife and six-year-old son.

• • •

FOR 35 YEARS, Kingston (Ont.) born **Hubert R. Sills** has been a member of the American Institute of Electrical Engineers. During this time he has done much to show that electrical engineering in this country has a mind and imagination of its own; he has 20 patents registered in his name and four others currently being considered.

Asked to name and describe his most important invention for DESIGN ENGINEERING readers, Hubert Sills declined. "There is no such thing as a total invention these days," he said. "I can't claim much more for mine than that they are all to do with efficient cooling and magnetic circuits."

But the Sills contributions to electrical engineering have been bigger than he allows; and now the AIEE, taking a backward look at all he has done and at his long membership of the institute, has announced his election to a Fellowship. It is a distinction won by few engineers.



HUBERT SILLS

Twenty patents and no time to mope

Hubert Sills has spent the whole of his working life with the Canadian General Electric Company. He joined the company's test course in 1921, was assigned to engineering with the a-c group. Twenty-four years later he had risen to become supervisor-design engineering, a-c machines. During recent CGE internal change-arounds (People page, DESIGN ENGINEERING, August) this title was changed to: engineer, vertical generators.

In his private life, AIEE's new Fellow is a family man with three children and six grandchildren. Despite a low-pitched unmusical adagio voice and the long unwaywardness of his career, he is a man of movement and changeable interests. Examples: For vacations he likes to "whirl through the United States." Asked about hobbies, he could think of none: "I get fed up with any one thing before it becomes a hobby. I don't fish or do anything like that."

Canada's leading generator man has little time for the lighter things in life. Besides his AIEE activities (he is a "rotating machinery" committee man) he is a long standing member of the Engineering Institute of Canada—chairman, since 1945, of its membership committee. And he represents the French Conférence Internationale des Grands Réseaux Electriques, in Canada.

What does he get in return for so much effort? Rasped he: "I meet a lot of leading engineers from Canada and the United States." Then a second answer followed; it gave a closer view of the Sills private philosophy: "With so much to do, I don't have time to mope."

Two separate patents cover inventor MacLean's Enjar Railroad Wheel he holds, Enjar Auto Wheel, left.

The Enjar Wheel Arouses Designers

Canadian - invented resilient wheel looms as transportation revolution

WHAT IS AN "ENJAR WHEEL?" And how will it affect the design engineering field? Logical questions!

The Enjar wheel is a revolutionary invention of 68-year-old James M. MacLean of Windsor, Ont., who has worked on the design of rubber resilient wheels for three decades.

If the predictions of eminent transportation engineers prove correct, the wheel may some day replace the pneumatic tire on all motor vehicles. But for some time its applications will be limited to service-type road vehicles as well as military and agricultural equipment. The railway version, however, may sooner replace conventional wheels on much rolling stock. This wheel, with modifications, is adaptable for streetcars.

"Enjar" is a coined word, described by inventor MacLean as being easy to say in many languages. It is a short form of the phrase "ends jar." That's exactly what it does, too. And the revolutionary way it does away with jar is a design milestone.

The rubber, instead of being stretched as normally, is compressed. Inserted between the hub and rim of the Enjar wheel, it not only stops jar and vibration, but virtually eliminates injury to the rubber because the stresses in it are so greatly lessened.

On motor vehicles, 80 per cent of road failures are shown by statistics to be the outcome of flat or punctured pneumatic tires. The adoption of the Enjar wheel with its solid tread would end such breakdowns.

Two types of Enjar wheel are under study by leading U. S. rubber companies at present. One is the rubber shear sandwich type for motor vehicles. The other, the railroad wheel, has pre-stressed rubber elements used in compression for rolling stock. A third wheel, particularly suitable for small rubber equipped vehicles such as caddy carts and baby prams, is known as the bogie wheel. It features the same basic construction as the motor vehicle wheel.

Continued on next page

Enjar wheel *(Continued)*

The Enjar road wheel not only improves riding qualities on both smooth and rough surfaces through the elimination of road shock, but also offers a better road grip. This is a result of the wheel's tendency to exert pressure on the road. Even annoying thumps caused by joints in concrete paving are prevented. And the old hazard of brake grab is ended.

All in all, general tests on resilient wheels using rubber have shown them to have outstanding advantages over the conventional rubber tire that is air-filled. A European motorcycle maker has even put resilient rubber wheels on some of his new machines.

American automotive engineers have not carried their investigations with the Enjar wheel to the extent of the Europeans. But it is apparent from even early research that an outstanding result of switching to the Enjar wheel in cars and trucks will be a reduction of costs through the use of smaller and lighter parts.

The Enjar railroad wheel consists of a hub element, rim element, and a resilient filler of rubber. Plates from the hub extend outwards to the rim but do not touch it. In the same way plates go from the outer rim towards the hub, but do not contact it either. The rim in this way is insulated from the hub by rubber. With modifications this wheel can be used on streetcars and heavy military vehicles such as tanks.

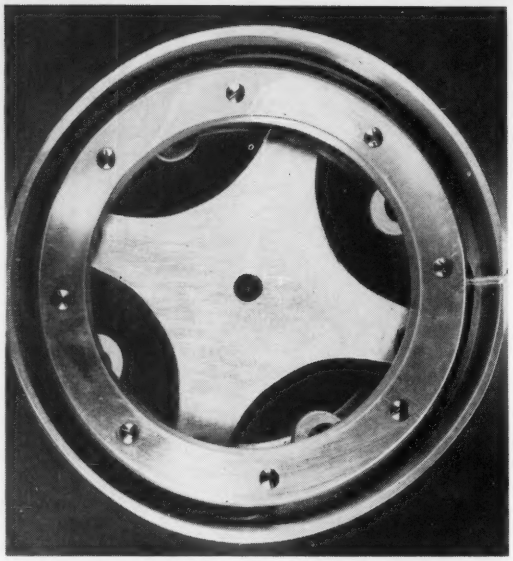
Engineers' studies indicate that adoption of the wheel by the railroads would mean a reduction of rolling stock weight. Millions of tons of non-paying freight are now being hauled across the country in the form of overweight cars. Lighter rolling stock would cause less wear and tear on the tracks and bridges. Crew and passenger fatigue would be lessened through the absence of vibration. Lack of vibration would in turn reduce damage claims on some fragile freight.

Although a Swedish resilient wheel has been made, its design has been shown by tests to be completely unsuitable for use on Canadian or American railroads. Since 1867, over 2,000 ideas have been registered in the U. S. Patent Office for resilient wheels, but no design has equalled that fostered by the Windsor inventor. Canadian MacLean has patents issued, pending and applied for in the U. S., Canada and Great Britain.

What is the reaction of the railroad officials to the revolutionary wheel? So far they have indicated their approval and want to see the wheel developed and put into service. The Canadian railways admit, however, that they do not pioneer in new equipment, but follow the lead of the American RR.

Inventor MacLean's 30-year quest began in 1918 but he was not actively involved in the design of resilient wheels until 1925. That year he took a loaded truck equipped with "biscuit" wheels from California east to Washington for tests by the Bureau of Standards. The wheels had rubber discs in shear placed in the opposite openings of the rim element. On the way east it attracted manufacturers, truck operators and street railway companies.

Tests by the Bureau in 1926-27 showed nonetheless that any advantage in the resiliency of the wheels was canceled by the extra weight. When he returned the truck to the west coast and turned in his report pioneer MacLean thought his job was completed. But the reports outlined almost unheard of speeds on solid tires.

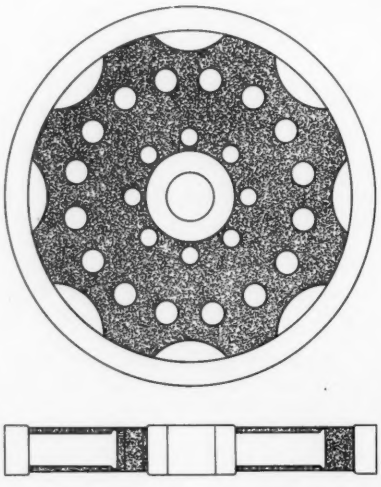


Resilient Enjar wheel invented by MacLean separates the hub and rim by resilient core, uses solid tire.

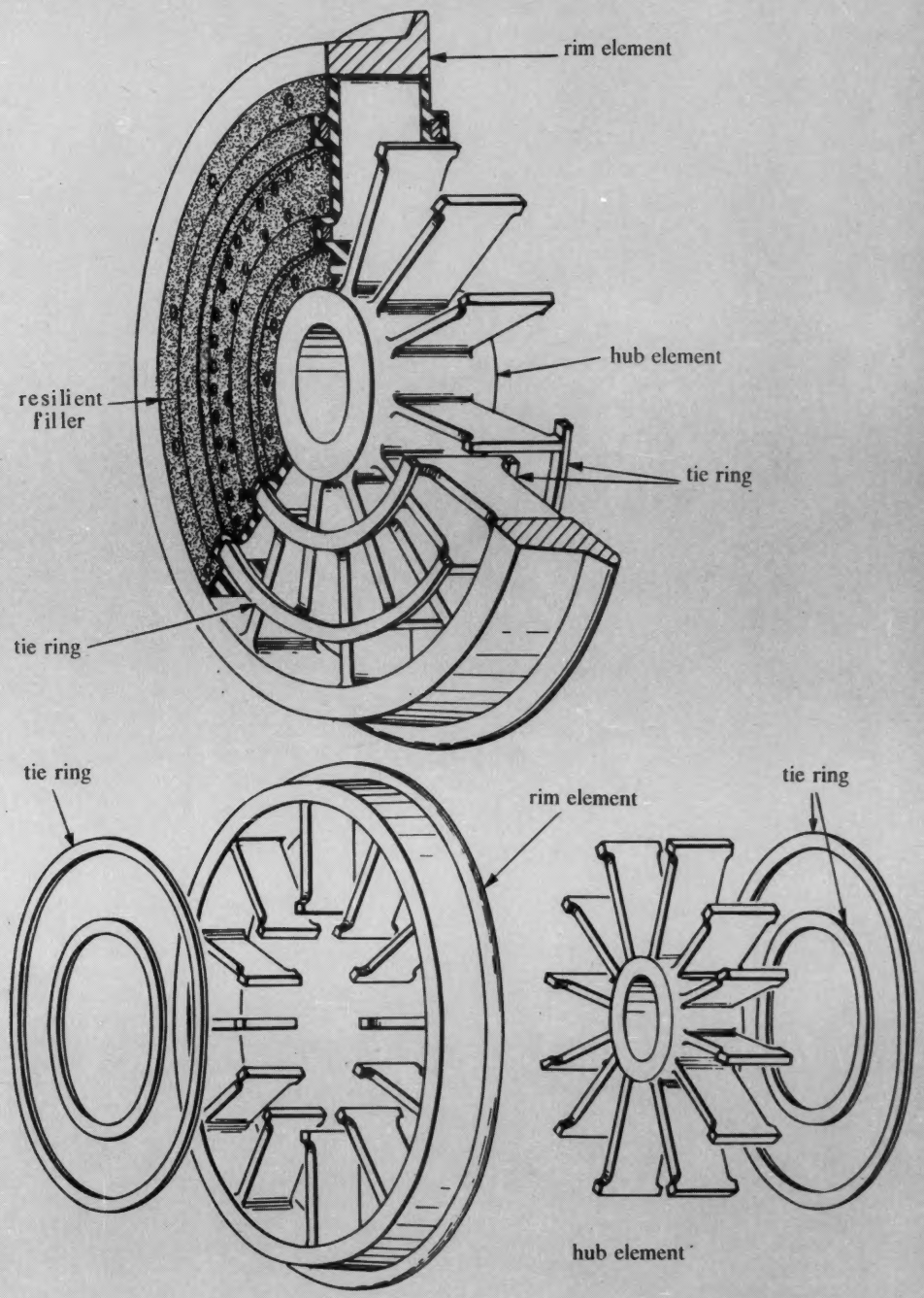
The group that had sponsored the trip were so enthused that they asked him to continue experimenting.

From that time on James M. MacLean's research for a successful resilient wheel progressed. This past summer after 13 years intensive work on the wheel since his retirement, the Prince Edward Island born designer, who had relentlessly championed the resilient wheel, climaxed his arduous research with a working model of both the motor wheel and railroad wheel.

The prototypes have now been made. Prospective producers are taking action. Eventually, it is possible that just about everybody and everything could be riding on the Enjar wheel. ★

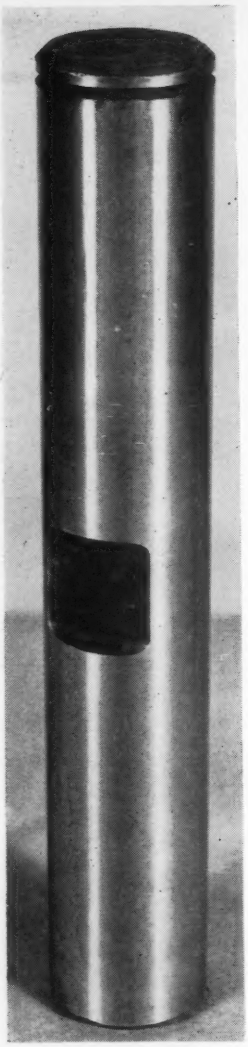


Same basic construction as Enjar motor wheel bogie is suitable for caddy carts, prams.



Enjar "C" Wheel

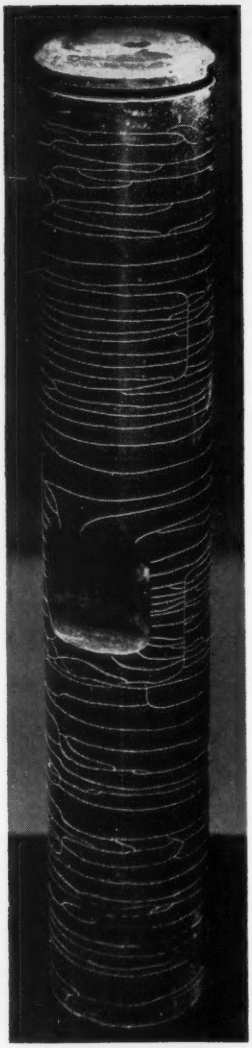
Wheel was originally designed for heavy military tanks requiring wheels of low diameter where a relatively heavy psi load is applied to the rubber. Bonded in place, the rubber has two stresses in it, simple compression and tension on the adhesions. Orifices through rubber make wheel more flexible and reduce pinching and bruising from an over concentration of load.



Magnetic Particle Inspection Is Design Defects Detective

LEONARD E. BAXTER
INSPECTION MGR. WILLIAMS & WILSON LTD.

Outside, inside, magnaflux and magnaglo uncover irregularities in metal components old and new by applying powder and current



Fluorescent Magnaglo reveals danger signals showing truck king pin, left, apparently in sound condition, rife with weakening cracks.

"WEAR AND TEAR" IN METAL, accompanied by its unglamorous companions fatigue and cracks, have occupied design engineers over the years in seeking ways to detect, then eliminate, this industrial hindrance. And they have been increasingly successful.

Magnetic particle inspection now enables engineers to pinpoint cracks which contribute to failure, and thereby design parts with a lower safety factor and reduced weight. This method, in use only 16 years, was developed under the trade name "Magnaflux." Its primary application is in finding surface openings, but it may also be used to find sub-surface defects. Playing two roles, it carries out the inspection of new materials and parts, and the inspection of used parts.

For example, truck and engine manufacturers apply it in service branches and automotive shops. City and inter-city bus and truck fleets use it as well. Construction companies, oilfields, pipeline stations and manufacturing plants call upon the method as part of preventive maintenance.

In step with the speed of the modern production line, it makes accurate inspection of every part a practical manufacturing phase. Speedy, the system shows immediately the exact nature of the flaw. The operator can readily detect surface or sub-surface seams and strings of non-metallics. These invisible discontinuities are revealed to him in steel billets, hot rolled and cold drawn bar stock, and forgings, to name a few applications. But the list goes on; for magnetic particle inspection works just as effectively in any steel part. Machine tools, springs, automotive and aircraft parts show up their fatigue indications by this method, also. Quickly and accurately the operator is able to estimate the size, depth, and importance of the crack or irregularity.

Magnetic particle inspection reveals every nature of a surface crack, distinguishes seams from roll marks, cracks from machine scratches, grinding checks from etching cracks, and sound welds from the faulty. It shows up steep cracks in steel parts before they become visible or dangerous. And it will locate defects that no other inspection method can spot.

Two techniques are used. The wet method which

consists of a paste of finely divided magnetic particles and light oil is the inspection medium for bright parts, ground or polished engine parts, and bearings. Sometimes it is used for inspecting unmachined forgings or castings. However, unmachined castings, welds, forgings and heavy machinery permit the speedy dry method procedure with no sacrifice in thoroughness. The inspection medium in this instance is formed with a powder of ferro-magnetic particles supplied in three colors, grey, black and red, which provide the greatest color contrast on various surfaces.

To understand magnetic particle inspection, it is necessary first to consider simple magnetism. Small pieces of steel are attracted to a magnet, the attraction growing as the magnet comes closer. The area where the force is felt is known as the external magnetic field. Since magnetic fields can only be detected when they travel through the air, the magnetic field flowing through the magnet itself is not visible. Now, this method of particle inspection meets the characteristic reluctance of the magnetic fields to be forced into the air. For this reason the magnetic field tends to stay within the iron or steel part until it is forced out by a sharp discontinuity.

Bend the ends of the magnet close together and the magnetic field between the two poles is much more concentrated and the attraction is considerably increased. Weld the ring-shaped piece and the magnetic field encounters no air gap. Under these circumstances it flows entirely within the ring with the result that there are no poles and no field leakage. However, if the ring is only partially welded much of the field will continue to travel through the solid steel, with the result that poles are set up on the surface of the metal at the sides of the break. There is a leakage of the field from one pole to another through the air.

Bring the small pieces of steel close to the leakage field and the pieces will be attracted by the magnetic leakage field and held there.

The basic principle of magnetic particle inspection is represented by this activity. It requires the setting up of a magnetic field and an interruption in it. The poles are then developed on the surface of the part to be inspected. The leakage field between the poles will attract and hold finely divided particles.

Magnaflux depends for its effectiveness on a crack or other cracklike break in a piece of magnetized material being located transverse to the direction of the magnetic field. When this condition exists, the field is distorted and the flux lines are crowded or deflected around the end of a magnetic obstruction.

When the obstruction lies near enough to the surface of the material, some of the flux lines will be crowded outside the material and a leakage field will be produced over the sub-surface irregularities. The nearer the surface the break is located; the stronger will be the leakage field. If the discontinuity breaks through the surface some of the particles will be attracted and held. When magnetic particles are applied by either the wet or dry method over the surface, a magnetically held pattern is set up. The leakage field becomes stronger with a greater obstruction in the magnetic path. Sharp deep cracks at right angles to the surface give the strongest patterns.

Large cracklike discontinuities below the surface which have a principal 90 deg attitude show strongly on the surface. Small defects, or defects of unfavorable shape must be close to the surface to be found at all.

The effectiveness of Magnaflux is affected by other factors. The stronger the magnetic current, of course, the stronger the field. While the current is flowing, the existing field is always stronger than the field that remains after the current is shut off. But due to the magnetic behavior of metallic materials there is still a very strong residual field after the current has stopped. It is not to be relied on as a general inspection method, but it may be sufficient to show indications of surface cracks even in 1020 steel.

It is better to apply the magnetic particles at the same time that the current is flowing in order to take advantage of the stronger field. This is called the continuous method.

The type of current—a-c or d-c—has a direct effect on the sensitivity of the magnetic particle inspection.

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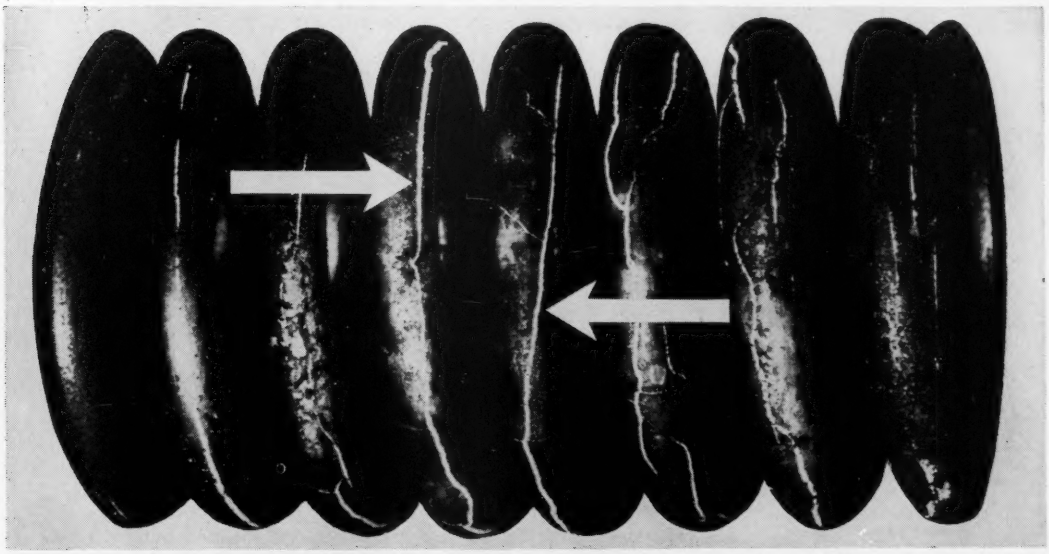
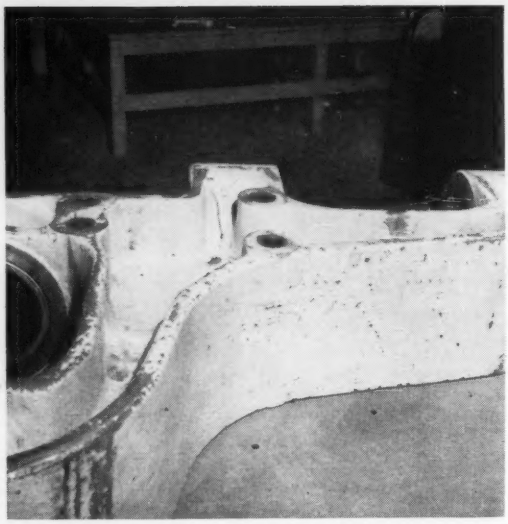


Auto valve spring under black light during the Magnaglo inspection is found unsuitable for further service.



Drive shaft yoke from earth moving machinery showed crack, centre, with application of Magnaflux powder.

Chipper plate from pulp and paper mill weighs 4½ tons, was inspected, then rewelded, is now back in service.

Above, field inspection is carried out by Magnaflux ac-dc unit with powder blower on ¾-ton pick up truck.

Magnaflux *(Continued)*

Alternating current is limited in inspection to the metal near the surface of the part, because a-c tends to flow along the top layers of the conductor, especially if it is iron or steel.

Direct current will penetrate more deeply into the cross section of the metal. So, to get the most sensitivity, d-c should always be used, unless the inspection is limited to the surface. Then, in some inspection work a-c can be better used.

Canada enters picture

A steady increase in interest has developed in Magnaflux to the extent that a Canadian company has opened inspection shops in Toronto and Montreal. During two years' operation, the shops have been multiplying business rapidly. Both locations are equipped to do shop and field inspection to RCAF specifications.

Williams and Wilson Ltd., sole agency for the system in Canada, have just finished inspection of the Westinghouse bullgears for the destroyer escort vessels presently being launched. These components, each worth several thousand dollars, must essentially be sound at the outset of their service life.

In working to exacting specifications on many jobs, inspection operators can tell precisely whether or not the part is fit for use. In other instances, where stress analysis is not specifically set down, they can only report. It is up to the client to take action and implement the information.

Several companies in Canada have their own inspection equipment, such as the railways, the Toronto Transit Commission, and the Toronto Hydro.

Overhaul on vehicles and machinery presents the most favorable opportunity to carry out the inspection. For example, a fleet owner of trucks, when he has his vehicles in for overhaul could still have a cracked crankshaft, which could be detected by the magnetic particle system.

In the same way, machinery overhaul affords a logical opportunity to apply the Magnaglo or Magnaflux method.

Inspection is valuable

Here are some practical examples of the value of inspection:

- A large Canadian oil company faced with the problem of welding an end cap for an oil refinery reactor, knew that previous troubles indicated a rigid inspection was necessary.

The spheroid shaped cap, 14 ft. in diameter of 1½ inch plate, was chamfered at the outer edge to permit several runs of welds when it was assembled inside a cylinder of 1¼ inch plate.

After the first weld was inspected, fourteen cracks were revealed which were ground out, rewelded and again inspected. After the tenth pass which filled the chamfered portion, another inspection was made showing defects. Six further passes were added to provide a filler, followed by a third inspection.

During the welding operation the local areas were preheated. Three nozzles were inspected and revealed three cracks which were satisfactorily repaired. The

unit was then stress-relieved and completely re-inspected. Seven cracks were found on parts of the subsidiary structure such as the insulating ring.

Following refinery inspection, the same oil company which had recently experienced a failure on a crane sling, ordered inspection of all slinging equipment they had.

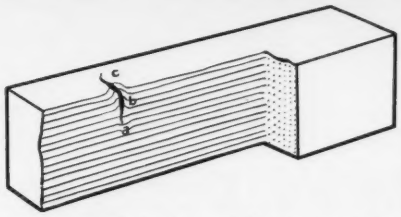
- In a job that involved an overhaul inspection of seven prefabricated boom sections, 93 defective weld clusters were discovered as well as six cracked end fittings.
- A routine boiler inspection revealed a few visible cracks in the fire wall extending into the tubes. At the request of the boiler manufacturers, a complete inspection of the walls showed the boiler to be extensively damaged.
- Several manufacturers have requested an inspection of crane hooks. One manufacturer sends new hooks to the Montreal inspection shop before they are shipped to the customers. One inspection detected a 3-in. forging lap on a 15-ton hook.
- A Canadian shipyard during the recent inspection of a propeller shaft located a 1½ in. defect, a fatigue crack, which was successfully ground out and fully repaired. On further inspection it proved fully capable of carrying out its original job which might have been cut short without the application of Magnaflux.
- Diesel railway spring inspection has been one of the biggest jobs handled by the Montreal shop of the inspection company.
- Pulp and paper mills have requested service recently. One company shipped a 4½-ton chipper plate from New Brunswick for inspection. The centre shaft had been sheared about 18 inches from the plate and had to be pressed out before it could be completely inspected. A crack was located on one of the ribs that went 1½ in. deep. Repaired by rewelding, the face plate will soon be back in service.
- Another mill recently had three failures on the journals of 20 ft reel bars. Failures on equipment of this nature creates a very expensive breakdown, so the mill has contracted for inspection of all its steel bars.
- Pressure roll journals in yet another pulp and paper mill were inspected and a series of fatigue cracks in the fillets of one ran from ½ in. to 3 in. long. This roll was immediately scrapped. This saved a costly failure during service.

On obstructed surfaces such as springs, the interior of tubes and borings where Magnaflux indications cannot be clearly lighted or viewed directly, Magnaglo is used.

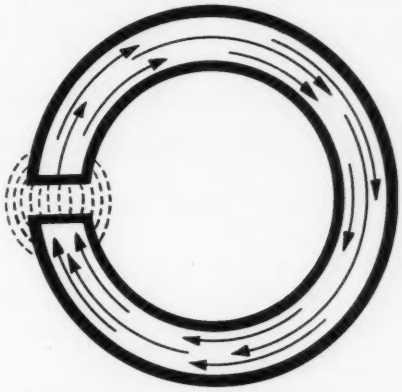
Applied by the wet methods, this inspection medium consists of a specially developed paste that is fluorescent under black light. The indications are the same as those made by the Magnaflux on correctly magnetized parts of steel and alloys by the distribution of the ferro-magnetic particles. Magnaglo is especially suitable for rapid production line inspection because it speeds up the visual inspection.

Magnetic particle inspection is therefore forming an integral phase of industrial progress in this country.

By unveiling the irregularities that may cause not only failure but disaster, magnetic particle inspection is charged with broad responsibilities. An awareness on the part of manufacturers of its value has transformed the high school experiment with magnet and iron filings into a national asset. ★

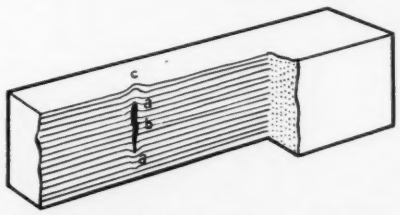


Lines of force (a and b) in steel bar and distortion (c) at crack are shown.



Above, ring magnet with lines showing magnetic field path between the poles.

This diagram shows leakage of a magnetic field in a magnetized ring after cutting.



Lines of force (a) in steel bar, distortion of field at sub-surface (b) and leakage (c).

Indium Cell Allows Designers Flexibility

Button size battery that will not leak, swell or gas uses an indium anode, offers unlimited life on shelf and in service

Tiny as half penny, indium cell will power Elgin electronic watch, find uses in universal design.

INDIUM, A SOFT silvery-white metal found in zinc ores has been mainly used to improve the mechanical properties of other metals by alloying it with them. Then, in aircraft for instance, indium has been used chiefly as a protective coating for engine bearings and airscrew blades.

Now it has been responsible for the development of a button size battery which will not leak, swell or gas.

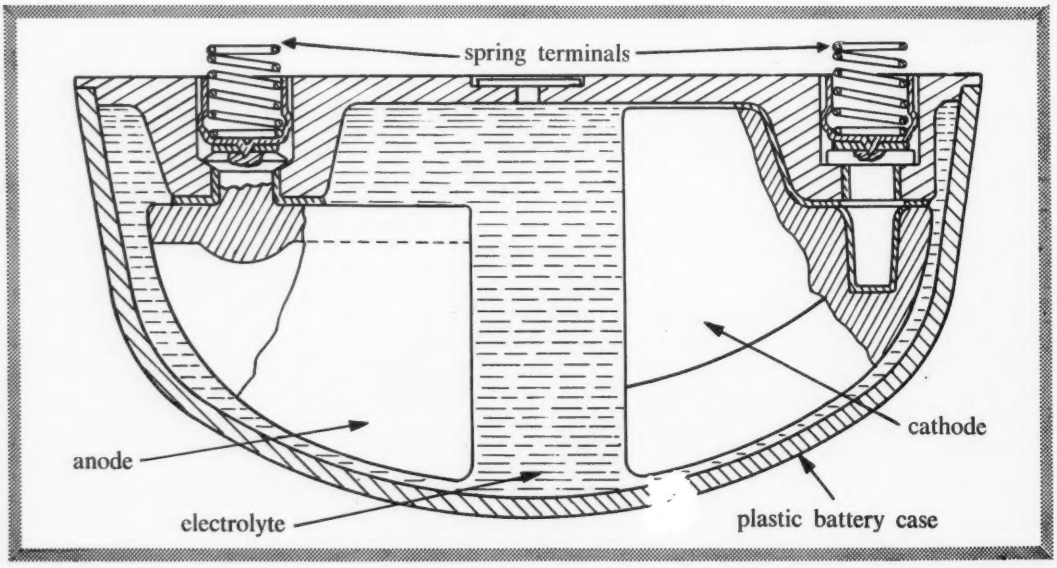
No larger than half a penny, the new cell was created by the Elgin National Watch Company for use in fine instruments, particularly its new electronic watches. Using indium in its anode, the battery is able to maintain full strength without deterioration. This has been proven by tests that have been going on for more than a year.

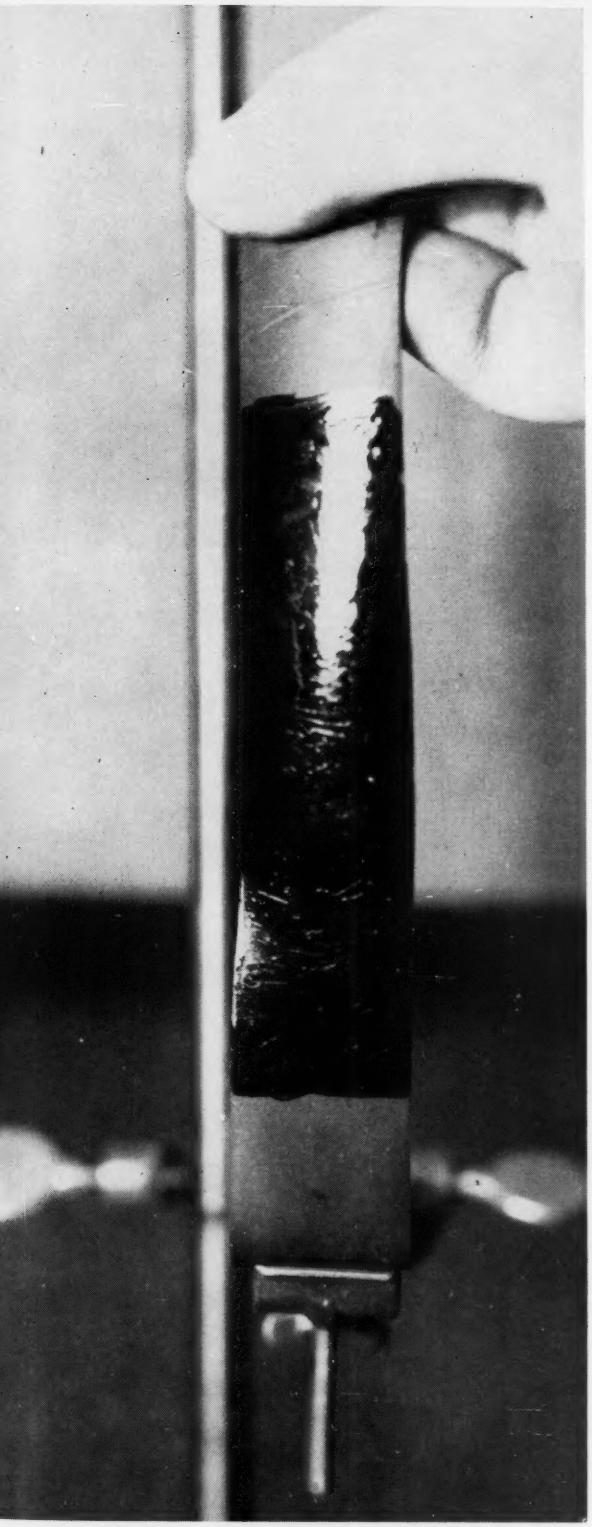
The new cell can be made in any shape or size. Designers therefore have complete flexibility in laying out devices that use miniature batteries. Most cells until now have been limited to a cylindrical shape.

Closest approach to the indium cell has been the mercury battery, which is presently in commercial use. But it has several disadvantages.

For example, side reactions occur during its storage and discharge, that cause the battery to swell. There is also electrolyte leakage. These reactions result in costly corrosion, especially where batteries are in a circuit close to expensive parts. Apart from that, they consume the battery's own components, which reduces its energy. Whereas the life of the mercury cell is limited, the new cell enjoys a virtually unlimited span of service.

Bulky carriers and separators have been done away with in the indium cell, **(Continued on page 64)**





High-gloss, tough, flexible and resistant coatings can be made for rubber from epoxies. Note sheen of strip in comparison with the rubber attached to the holder.

Engineers Conquer Stubborn Proposals With New Epoxies

Available since 1950, the epoxy resins are versatile products that offer the design personnel a chemical "way out"

FRANK CHATTERTON

HOW OFTEN is a sound development scrapped because some needed material cannot be found? It certainly happens. And sometimes the engineer would find that if he looked more carefully at chemistry as a structural science, the material he needs is available to him after all.

Epoxy resins are versatile products that have often been a chemical 'way out" in these situations. They have only been available commercially since about 1950; but even in this short time, their properties have shown them to be a wonderful tool to the science of design.

Wetmore Hodges and Associates of California, in co-operation with the Shell Chemical Corporation recently introduced a startling motor-compressor design. It shows clearly how fundamental the effects of the use of epoxies can be.

This compressor is really just a simple modification of an electric motor. The compressor mechanism is placed inside the motor itself. Two gears form pressure chambers to provide a positive displacement pumping action. Instead of being attached to an axle, the rotor unit turns on bearing rings that separate it from the starter. An eleven-tooth gear attached to the inside of the rotor cylinder, meshes with a nine-tooth gear on a through-bolt. End plates rotationally position the inner gear, and the outer one attached to the rotor. The meshing of the two gears, with their mating teeth, acts like a rotating eleven cylinder compressor. Displacement is 1.5 cubic feet per inch. There are only two moving parts—the rotor and the inner meshing gear. The unit is intended for use in refrigeration and air conditioning, but may also serve as a motor-pump for liquid fuel.

The secret of this design is the potting and total embedding of the stator with epoxy resin. This allows it to work as a fluid-tight pressure vessel. The structure is leak-tight up to 350 psi **(Continued over page)**

at temperatures from —20 deg F to 250 deg F. There's enough elasticity in the resin to follow thermal changes in the iron-copper structure.

What are the advantages? This ½-hp unit is only a quarter the size of conventional models. The motor driven compressor gives more than 50% weight reduction, with only 12 parts.

Much significance to this . . .

There is much significance to all this. There are many forms of machinery that are essentially shafts rotating inside cylinders. Pumps, mixers, and milling and grinding machinery are examples. Electric motors are constructed on the same basis. When they are used to drive machines having similar construction to themselves, a highly potent and functional design opportunity is lost. The motor-compressor described above is possibly the first design to take advantage of this characteristic.

And the use of epoxies caused its success. There is no doubt that the enlarged use of the principle involved can add much design potential to the electric motor field.

Basically, this is just another example of the broad usefulness of potted electrical circuits. The miniaturization program now going ahead at speed is demanding more and more potted circuits. In the past, radio equipment and aircraft control devices, needing protection from the elements, were sealed in oil-filled containers or embedded in tars, pitches, waxes, and similar materials. These methods are unsuitable for some of our modern needs. They lack mechanical strength, heat resistance, chemical resistance, and often shrink excessively on solidifying.

The epoxies overcome almost all these shortcomings. These liquids are mixed with a suitable curing agent, and poured at room temperature around the circuit. The liquid shrinks 2% in changing to a gel.

And this shrinkage has no effect upon the circuit at all. In going from a gel to the final hard-cured resin, there is a further 2% shrinkage. This slight change allows embedding delicate electrical equipment such as vacuum tubes, and full miniaturized electric circuits like those used in hearing devices. The low cure temperature has no harmful effects upon most components. Electrical properties are excellent.

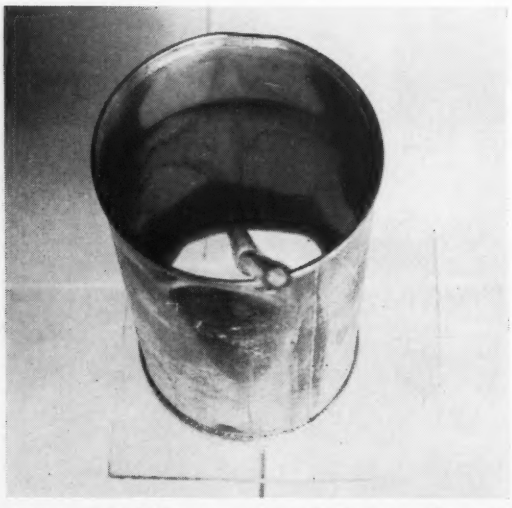
Much is known and has been written about glass fibre-polyester laminates. These structures allow the tremendous tensile strength of glass filaments to be used in the production of high-strength molded laminates.

One of the important potential uses of these materials was in the production of high pressure piping and tanks. But the elasticity of glass fibre caused trouble here. These filaments do not, like steel, have elastic limits beyond which they will permanently deform before breaking. They will stretch to their elastic limit and fully recover when the pull is removed—or they will break. But their limit of elasticity is 3% of their length. This is 10 times as great as steel. Such elasticity allows a sizeable expansion to take place in pressure vessels. With a bonding resin like polyester, which had no such stretch properties, these vessels tended to leak under pressure.

The epoxies provide a means of overcoming this trouble. They have enough elasticity to stretch with the fibre without cracking. And so the leak problem is eliminated. High pressure air storage tanks for jet aircraft starting systems are now being made in spherical form using these resins. The Apex Electrical Company is producing them from one continuously wound strand of epoxy-impregnated glass fibre. With lower pressure tanks, like those used for storing crude oils, polyesters are continuing to do good service. But two firms making them, the National Tank Co. and the Murdock Tank and Mfg. Co., (both of Oklahoma) agree that the epoxies stand up to tougher uses.

Polyester-glass fibre laminates have been found wanting in many important applications involving the need for abrasion resistance. Both the Canadian and the U. S. armies have made extensive tests with them Results, as far as wearability of the surfaces went,

Nearest the ideal of sticking anything to anything new adhesives from epoxies



A leak-proof joint was made easily between this metal cylinder and glass, using epoxy/polyamide adhesive.

were disappointing. Unlike polyesters, the epoxies, (particularly those made by blending with reactive polyamide resins made by General Mills Corp.) have very good abrasion resistance. There is no doubt that these slightly more expensive resins, used at least on the surface of such products, would greatly improve them.

The epoxies both alone and blended with other coating resins, have qualities which must strongly influence design. As far as volume of resin sold is concerned, most of these resins go into coatings in the form of alkyd-like esters, made with fatty acids recovered from vegetable oils. While these make improved air-dry and baked finishes, the truly stimulating end-products are made with the catalyst-cured pure epoxies.

A good example has come from the Douglas Aircraft Corporation. A finish was needed to protect the exhaust-path metal surfaces on DC-6 and DC-7 aircraft. These finishes had to withstand wind and rain erosion at speeds up to 400 mph. The temperature of the hot gases went up to 300 deg F, and the finishes were exposed to the strong solvating effects of Skydrol hydraulic fluid. They had to be available in various colors, and must have adequate water resistance to remain intact under all weather conditions. Finally,

they had to be entirely practical to apply and maintain.

Of over 300 coatings tested, only those made from epoxies were successful. And these are so good that one airline operator reports coatings still satisfactory after 1,000 hours operation.

Another peculiarity of epoxy finishes is their power to protect metal from corrosion of themselves. The National Engineering and Manufacturing Company (of Missouri) had a rusting problem of long standing with their home and industrial evaporative coolers. This problem persisted despite the use of best rust inhibitive primers over phosphatized surfaces, followed by top quality baked-on enamels. When an amine-cured epoxy coating was used over the primer, it was found that refunds due to corrosion in use, ended and the product also had much improved sales appeal.

This was in 1952. By the end of 1953, results were found to be so good that a further, quite surprising step was taken. It was decided to eliminate the primer, and depend completely on a single coat of epoxy finish only 0.75 thousandths of an inch thick. The coating was baked, after six minutes air dry, for nine minutes at 300 to 325 deg F. Results continue to be as effective as those with primer.

This is a most unusual situation. It is known in the finishing field that no protective coating is completely moisture-vapor proof. The limited amounts of moisture that can penetrate any finish will lead to corrosion, if a rust inhibitive primer containing such pigments as lead oxide or one or more of the metallic chromates is not used. These create a rust inhibitive condition on the metal surface because of the combined effects of alkalinity, and nascent oxygen in the pigments. These effects interfere with the electrolytic action that must take place with rusting. The fact that an epoxy film can be used by itself, indicates that it has rust inhibitive qualities of its own. This can be explained, possibly, by the effects of the basic nature of the resin, and the alkaline catalyst used with it.

This points to an exciting design possibility. Highly polished steel or other metallic parts coated with a clear epoxy finish could be expected to keep their mirror finish. It is highly possible that expensive nickel and chrome plating might be replacable by this treatment for many applications.

Another outstanding property of epoxy finishes is that they can be applied thickly in one coat. Liquid grades are available which can be applied at 100% solids. In fact with fillers added to prevent their flowing over uneven contours, there is almost no limit to the thickness these coatings can be applied. Methods include trowelling, spraying, brushing, and (to a limited degree) dipping. The last method is not too practical because the liquid has a pot life at most of only a few hours at high solids content. This leads to curing in the dipping container.

Two-component spray guns are quite useful with these coatings. This equipment allows the coating to be mixed with the catalyst just as it leaves the spray head. Of the many design problems which can be solved with its use, the filling of porous castings is a quite obvious example.

In combination with liquid polyamides, epoxy coatings can be made very rubbery and flexible. They have great resistance to attack by most inorganic chemicals, as well as organic solvents, greases, heat and weather. For many years paper convertors have been looking for these properties. And packaging for edible fats is an outstanding potential use. These are normally lined with special papers, which prevent contact with the outer cardboard container. But despite the closest attention to filling perfection, drops continue to fall occasionally between the paper and the outer container during the procedure. This can, and does lead to contamination.

Packers of these materials — lard, oleomargarine, shortening and so on have been looking for a coating that could be put on the cardboard so as to eliminate the inner lining and the danger of rancid odors. Such a coating has to be thin and tough and rubbery enough to resist the creasing of the cardboard without being cracked or penetrated. The tough, flexible polyamide-epoxies are prime candidates for the job.

Adhesives made from the epoxies come the nearest to the ideal of "sticking anything to anything." They will bond metals to metals, in any combination. In addition, combinations of metals, rubber, glass, plastics, leather, paper, and fibres are possible to effect without limit. About the only surfaces they won't stick to are polyethylene, fluorinated polyethylenes, some silicones and of course, greases and waxes.

The aircraft industry has been using them for a while. Goodyear Aircraft and North American Aircraft are well known companies doing so.

The adhesives are almost always in 100% solids form. They give optimum bonds with some baking, but room temperature cures are usually adequate. The catalyst is blended in just before use.

Designers have still barely scratched the labor saving potential of these products. Where many rivets or other fastening means are used to hold two metal sheets together, much time could be saved with epoxy adhesives. Riveting could be reduced to the point where just enough would be used to tack the surfaces together until the adhesives set. An obvious advantage of such a joint would be complete **(Continued over page)**

bond metals to metals, and combinations of metal, rubber, glass, paper, plastics

In another operation, the epoxy/polyamide paste mixture is poured into aluminum foil mold from container.

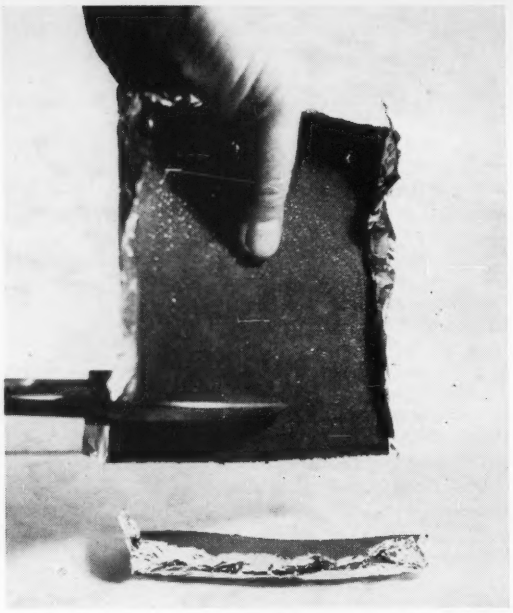
waterproofness. Think of the value in reducing corrosion between metals and stopping moisture penetration into the insulation of appliances like refrigerators and freezers!

Epoxy resins are available from several prominent chemical manufacturing firms. Full technical data on how to use them and blend them with catalysts are freely given by these suppliers. They are sold under several trade names such as Epon and Araldite. The major producers are Shell Chemical Corporation, Ciba, Bakelite, Ferro Chemical Corp., and Devoe and Reynolds.

Amine curing agents are available from several sources suggested in these firms' literature. Newer, and quite important curing resins, are available from General Mills Corp. These have advantages over the amine catalyst in that the proportion in which they must be mixed is not nearly so critical. Unlike the amines, curing is not harmed by the presence of moisture. In addition, different flexibilities can be had by varying the ratio of polyamide to epoxy. The blends have improved weather resistance, but somewhat reduced solvent resistance. Results up to now appear to show that polyamide-epoxy blends give outstanding adhesive characteristics. The resins now being made, which will cure the epoxies, vary from a tacky rubbery solid to a viscous liquid at room temperature. They are called, in order of increasing viscosity, Polyamide 125, 115, 110 and 100.

The epoxies are but another group of chemical products which open up exciting possibilities to the design engineer. Reputation of men in the field can be greatly enhanced by gaining a knowledge of what these products will do. With the general lack of knowledge of the place of products like the epoxies in design—their application can make many "just fair" jobs, outstanding ones.

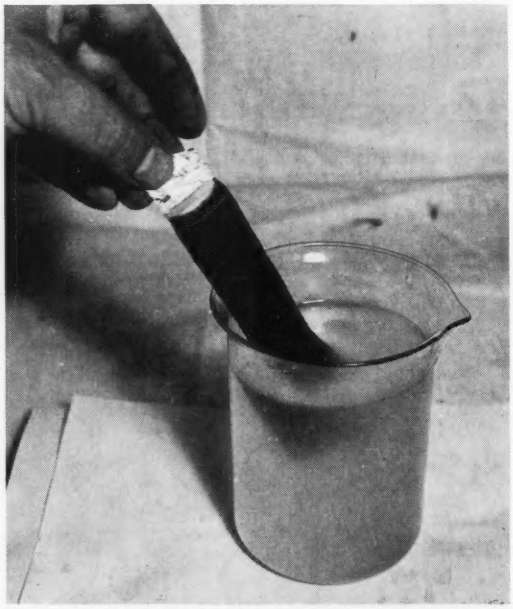
Many of tomorrow's designs won't be possible without them. Many of today's problems will find unique solutions by their use. They have become a must in all studies of new product construction. ★



When the paste sets, a tough leathery resin is formed which is cut with metal snips as in the photo above.

What is an Epoxy?

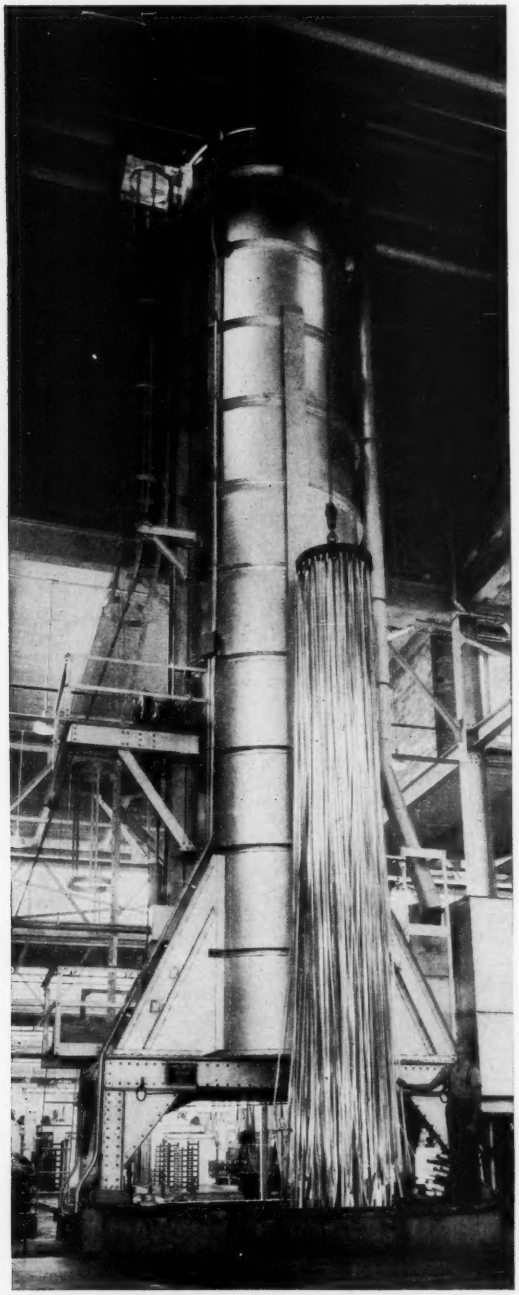
Epoxies are new types of condensation polymers. Certain polyamines react with epoxies to produce both chain and lattice polymers. With triamines and other polyamines having three or more nitrogen atoms in the molecule, lattice structure polymers are formed in addition to straight chain. When liquid polyamide resins react to form polymers with epoxies, active unreacted hydrogen atoms attached to nitrogen form the centres through which the condensation takes place.



Foil sticks so tightly that bath of strong lye has to be used to remove it, yet the lye does not hurt resin.

Heat Treatment Strengthens Aluminum

Giving the alloys added strength, it includes solution heat treatment, annealing, stabilizing, stress relief, and the homogenizing processes



Solution heat treatment of extrusions takes place in this vertical heat treating furnace 45 ft in height.

J. F. WHITING, B.Sc.
ALUMINIUM LABORATORIES LTD.

ALUMINUM IS USED MAINLY in the form of alloys, which are much stronger than commercially pure aluminum. Heat treatment of aluminum, one of three ways to give alloys their added strength, includes solution heat treatment, annealing, stabilizing, stress relieving and homogenizing. The other methods consist of adding alloying elements and cold work such as rolling or drawing. All three methods may be used singly or in combination.

Aluminum alloys are divided into two main groups: wrought alloys and casting alloys. In wrought alloys the cast metal is worked mechanically by processes such as rolling, drawing, extruding or forging, while in casting alloys the metal is cast to its final form. Both wrought and cast alloys are further divided into two general classes, depending on whether they are heat-treatable alloys or otherwise.

The wrought alloys fall into several groups, each group being distinguished by one main alloying constituent (see Table 1). These alloys are all distinguished by the symbol S immediately following the alloy number.

The nomenclature for the casting alloys is so arranged that the alloy numbers give a rough indication of the nature and percentage of the main alloying constituent. For the main alloy groups, see Table 2.

The non-heat-treatable alloys are those in which the mechanical properties are determined by the alloying element added, and/or by the amount of cold work introduced after the last annealing operation. In the case of casting alloys the as-cast strength is determined by the alloying elements added, their amounts, and the conditions of casting.

In the non-heat-treatable wrought alloys, five tempers are available although all tempers are not always supplied for each alloy or product. These range from the soft or annealed temper designated by the symbol O, to the full-hard temper designated by the symbol H, which is produced by the maximum amount of cold work that is commercially practical. In addition, there is the F or "as fabricated" temper. The properties represented by the various tempers are destroyed by subsequent heating and cannot be restored except by additional cold work. For the five tempers, with the symbols used to describe them, see Table 3.

The heat-treatable alloys are those in which the mechanical properties may be improved by heat treatment. In contrast to the non-heat-treatable alloys, the increased strength is obtained with little sacrifice in ductility. Heat-treatable alloys have the further advantage that they can be heat-treated again after annealing

to restore their original properties. There are eight tempers in which the wrought heat-treatable alloys may be obtained but each alloy or product is not always supplied in all tempers. For the symbols following the alloy numbers that are used to describe these tempers, see Table 4.

The strength of casting alloys resulting from the addition of metallic ingredients may, in some alloys, be improved further by heat treatment. For the symbols following the alloy numbers that are used to describe the heat treatment, see Table 5.

The W temper for any casting alloy is not distinguished, other than by the symbol. However numerals are suffixed to the symbols A and T to identify the precipitation heat treatment that has been employed. Thus, a full casting alloy and heat treatment designation might be Alcan 125-T22 or Alcan 125-A43.

pressure deforms crystals

Metals are composed of a large number of crystals, one of which is represented by (a) in figure 2. Within each crystal there are many planes on which movement may take place and these are known technically as slip planes. In an operation such as rolling, forging, drawing, bending or extruding, the pressure applied tends to deform the crystals, causing one portion of the crystals to slide with respect to those adjacent to it on the slip planes, as shown in (b) of figure 2. As the resistance to slip on these planes increases, slip takes place on fresh planes and the process is repeated. At the same time slippage is occurring in the other crystals composing the metal and in this way deformation is accomplished.

Resistance of a metal to slip may be increased by mechanical or cold working, by the addition of an alloying element (or elements) which raise the cohesive strength between atoms, and in certain alloys, by heat treatment. Heat treatment improves the distribution and size of the constituent particles which interfere with slip. It is not the purpose of this article to discuss the many theories on how heat treatment interferes with slip, but rather to describe the practical aspects of the various heat treatments.

An alloy is defined as an aggregate of two or more elements, which may be present separately in a mechanical mixture, in a type of chemical combination as intermetallic phases or in true solution. Both these last two forms, and occasionally all three may be found in the same alloy. Solution heat treatment is a means of attaining even dispersal of the soluble alloying constituents in the aluminum matrix (the base metal) by making use of the fact that some metals and compounds are more soluble in aluminum at high temperatures.

In the case of metals, the solution and precipitation may take place in the solid state and therefore solution of one metal in another is known as solid solution. The solubility of one metal in another is influenced by the temperature; the higher the temperature the greater the solubility. Conversely, when the solution is cooled, the soluble element, if present in sufficient quantity, will precipitate out of solution. In the case of a solid solution of a metal, such as copper in aluminum, the copper dissolved at a high temperature may be retained in solution at room temperature by quenching rapidly in cold water. However, this is a super-saturated solution which is in an unstable or strained condition. The aluminum tends to expel the copper from its structure in the form of a copper-aluminum phase, and in suitable circumstances will do so over a period of time.

TABLE 1

99.5% minimum aluminum	Alcan 1S
99.0% to 99.49% aluminum	Alcan 2S
Manganese group	Alcan 3S to Alcan 9S
Copper group	Alcan 10S to Alcan 29S
Silicon group	Alcan 30S to Alcan 49S
Magnesium and Magnesium Silicide group	Alcan 50S to Alcan 69S
Zinc group	Alcan 70S to Alcan 79S

TABLE 2

Silicon group	Alcan 100 - Alcan 199
Copper group	Alcan 200 - Alcan 299
Magnesium group	Alcan 300 - Alcan 399
Zinc group	Alcan 400 - Alcan 499
Manganese group	Alcan 500 - Alcan 599

TABLE 3

O	fully annealed
½H	one-half hard
¾H	three-quarters hard
H	fully hard
F	as fabricated

TABLE 4

O	fully annealed
W	solution heat treated
T	solution heat treated and aged
RT	solution heat treated, aged and cold worked
RW	solution heat treated and cold worked
F	as fabricated
A	quenched and aged
Q	quenched

TABLE 5

W	solution heat treatment only
A	precipitation heat treatment only
T	solution heat treatment and precipitation heat treatment

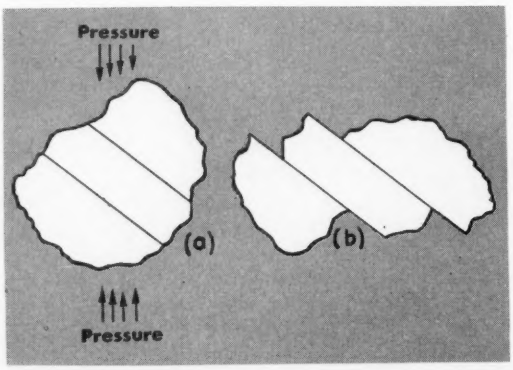
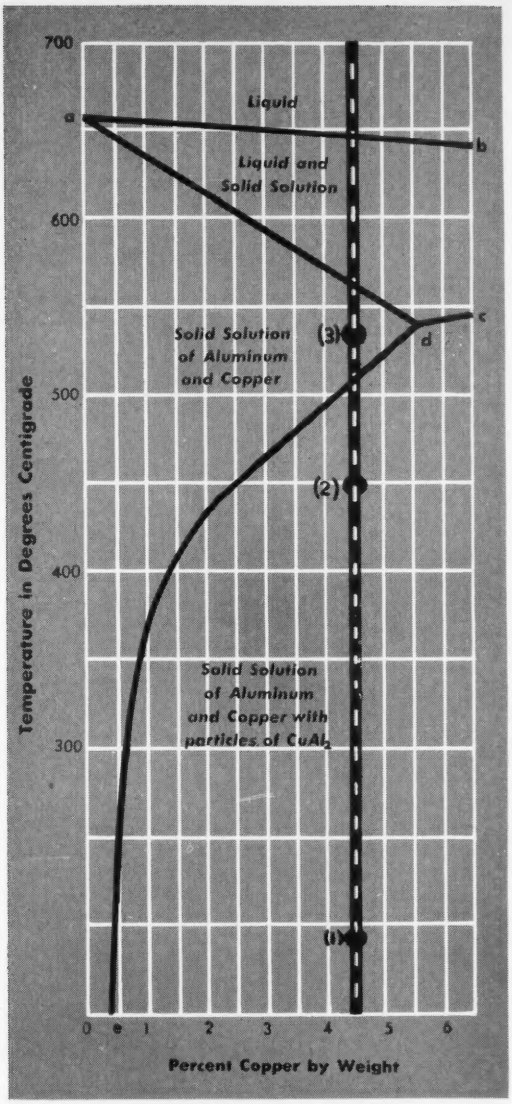
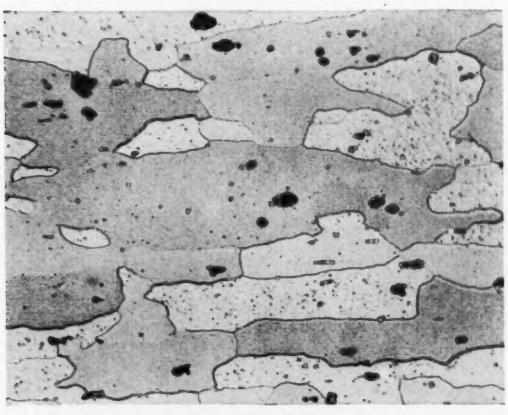


Fig. 2, shows crystals (a) before pressure has been applied to move them in slip planes, to shape as (b).



Graph illustrates solubility of copper in aluminum.



Above, aluminum alloy, 24S-T, commonly used in aircraft.

Heat treatment *(Continued)*

It is during the stages of atomic rearrangement and the commencement of precipitation that the precipitating phase or constituents offer the greatest interference to slip which results in increased mechanical properties. The copper-aluminum phase thus precipitated is very fine and is dispersed uniformly throughout the matrix.

An example of the solution of one metal in another is that of 4.5% copper in aluminum, indicated by the heavy barred line in figure 3. It should be noted particularly that this represents copper and aluminum without other impurities. At temperatures below 200 deg C (392 deg F) (Point 1) aluminum will retain in solution approximately 0.5% copper. In a photomicrograph this cannot be distinguished in the white background which is the matrix of the alloy. The remaining 4.0% is visible in the form of the copper-aluminum phase distributed throughout the structure in particles of varying size. On heating to 450 deg C (842 deg F) (Point 2), the amount of copper which goes into solution increases to 2.7% and a photomicrograph would show irregular copper-aluminum phase particles are becoming fewer, the smaller particles dissolving more rapidly. At about 515 deg. C (941 deg F) (Point 3) all of the 4.5% copper has gone into solution. At a temperature of 530 deg C (986 deg F) a photomicrograph shows all the copper in solution and thus no particles of the copper-aluminum phase are visible. This represents the conditions at a temperature slightly above the point where the line of solid solution d-e crosses the heavy barred line representing 4.5% copper. The line d-e is the boundary above which there is complete solid solution. If the alloy were quenched from this temperature by plunging quickly into cold water, most of the copper would remain temporarily in solid solution, and the metal would be harder than in the annealed condition, but soft compared to the fully aged alloy. The finely precipitated copper-aluminum particles would not be evident.

After quenching, straining

The changes in structure described above, with the exception of quenching, require a certain period of time at temperature. The length of time depends on the alloy as well as the constituents and their size, and is best determined by experiment. For instance, cast products require a longer time at temperature than do wrought products which have had their structure deformed by cold work.

After quenching, the aluminum-copper alloy is in a strained, unstable condition and some of the copper tends to precipitate out of solution in the form of a copper-aluminum phase. This takes place at room temperature in a relatively short time and is called "natural aging." The extent to which natural aging will proceed depends on the presence of small quantities of impurities or alloying constituents, the form of the material (i.e. whether as cast or heavily cold worked), the time interval and the subsequent thermal history. These, in turn, affect the mechanical properties of the metal.

The condition after precipitation is largely completed is illustrated in figure 4. This is a photomicrograph of a piece of Alcan 24S sheet which has been solution

heat treated, quenched in cold water and aged at room temperature for five days. Although the submicroscopic particles are not visible within the grains, they impede movement on the slip planes. The large dark particles are insoluble constituents of various intermetallic compounds, which remain out of solution and are not affected very much by the heat treatment. The metal in this condition is strong and hard. The natural aging curves for Alcan 24S-T alloy sheet are shown in figure 5.

Certain alloys, such as Alcan 26S and 75S, do not develop their maximum mechanical properties by natural precipitation at room temperature. They must be artificially aged for a number of hours at elevated temperatures in the range of 120 deg C to 200 deg C (248 deg F to 392 deg F). In alloys of this type there is a greater stability at room temperature of the supersaturated solid solution, but this may be overcome by heating to moderate temperatures, thereby permitting precipitation to take place. This precipitation heat treatment or artificial aging must be controlled carefully, because hardening will increase with time up to a maximum and then decrease as the precipitated particles begin to coalesce. At higher temperatures the maximum strength will be reached more rapidly and likewise the strength will fall off more quickly, thus giving less leeway in the range of time for the precipitation treatment. Figure 6 gives the artificial aging curves for Alcan 26S-T alloy extruded rod. The artificial aging temperature used was 170 deg C (338 deg F).

As mentioned earlier, when a piece of ductile metal is deformed by cold work, movement takes place along the slip planes of its crystals and the latter become strained as their internal structure becomes distorted. This state of strain causes an increase in strength and hardness and a reduction in ductility. Work hardening is a progressive process and the degree of hardening and the resistance to further deformation are dependent on the amount of cold work applied during the process.

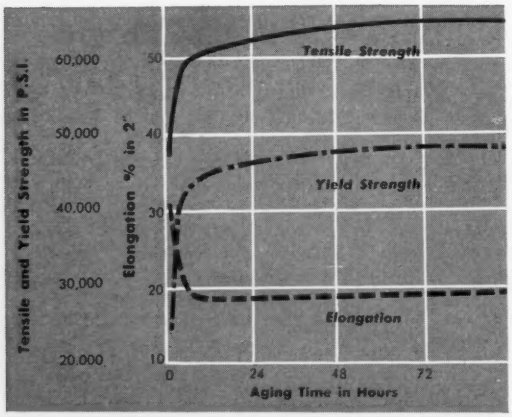
Annealing of work-hardened material consists of controlled heating at a temperature within the range of 340 deg C to 400 deg C (644 deg F to 750 deg F) with the object of partially or completely softening the material by removing the effects of cold work and allowing the material to reach a stable, unstrained condition. Annealing improves ductility and renders the metal more suitable for forming or cold reduction by rolling, drawing, etc.

The annealing process is essentially one of recrystalization during which the original grains, deformed by cold work, are replaced by new ones of substantially equiaxed form. The speed of growth of new grains depends on temperature and duration of heating as well as upon the amount of prior deformation. Final grain size tends to be greater for small amounts of cold work than for larger amounts. To ensure a satisfactory grain size the heating rate should be as fast as possible and the duration at temperatures only sufficient to cause complete recrystalization.

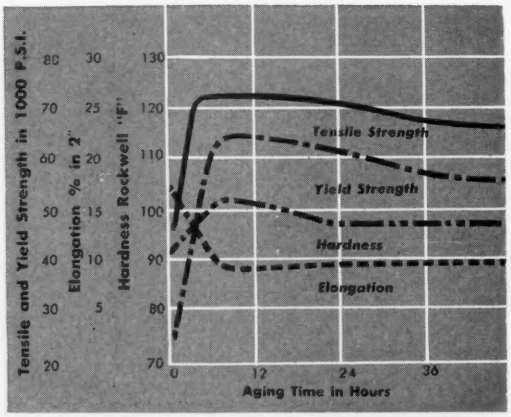
Material in the solution heat treated and aged condition may be annealed by controlled heating at a temperature within the range of 400 deg C-450 deg C (750 deg F-840 deg F). The heating removes the effect of any work hardening which may have been introduced by stretching, roll flattening or other cold working subsequent to heat treatment. However, its main function is to neutralize progressively the effects of age hardening by causing the submicroscopic particles to coalesce and thereby increase in size and decrease in number, with a subsequent loss in hardening effect. The rate of cooling after annealing should be sufficiently slow to ensure that constituents taken into solid solution are precipitated. The material should be cooled to 260 deg C (500 deg F) at a rate not greater than 30 deg C (50 deg F) per hour.

Prolonged annealing and the use of higher temperatures both cause excessive grain growth as in the case of work-hardened alloys. Heat-treated alloys which have received a small amount of cold work show the same tendency toward excessive grain growth. In the case of certain alloys, such as Alcan 17S and 24S, annealing affects the resistance to corrosive influences.

The mechanical properties of all tempers, other than the annealed, of Alcan 57S and other aluminum-magnesium alloy products change slightly over a period of time, the strength and hardness becoming less, and the ductility, as measured by elongation, increasing. Therefore, to gain ductility and to establish the alloy in a stable condition prior to use it is usually subjected to a stabilizing treatment; for Alcan 57S the treatment is approximately four hours at 150 deg C (302 deg F). The explanation is probably that in these magnesium solid-solution type alloys, the rearrangement of the atomic structure and the precipitate which results is of such a particle size that hardening does not result as with certain other hardening constituents, but a loss in properties results owing **(Continued on page 56)**



Shows natural aging curves of Alcan 24S-T Alloy Sheet.



Artificial aging curves: Alcan 24S-T Alloy extruded rod.

Marine Steam Turbine Is Challenged

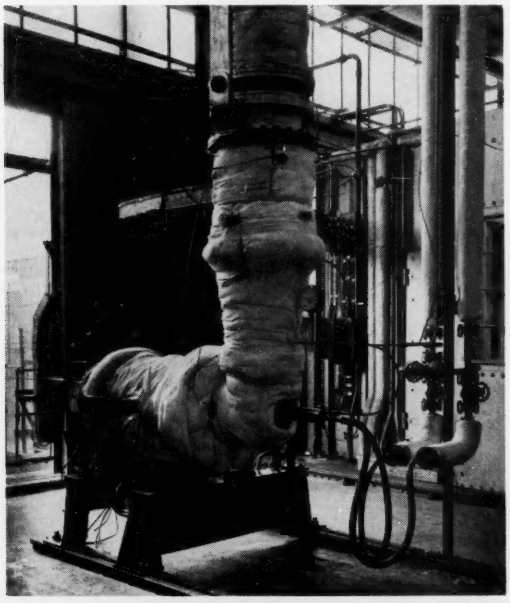
By A. G. THOMSON
SPECIAL U. K. CORRESPONDENT

Sturdy opponent, the gas turbine offers added efficiency, uses cheap fuel

GAS TURBINES FOR SHIPS present problems quite different from those encountered in the aircraft industry. In the first place, it is necessary to provide for a life of at least 100,000 hours at full power, corresponding to rather more than twenty years' service. Throughout this long period, absolute reliability is essential. On the other hand, the normal life of gas turbine engines for the propulsion of aircraft is not much in excess of a thousand hours. Whereas on aircraft gas turbine uses high-grade fuel, a marine gas turbine must be able to use a fuel which is cheap and available at all refueling ports.

Gas turbines offer several advantages over other forms of marine propulsion. The engines can be considerably lighter than steam turbine installations; they have greater efficiency than steam plants, and if they can burn fuel of the same grade, the fuel bill should be less. Gas turbine machinery can reach full-power output in a matter of minutes, in contrast to steam turbine machinery, for which steam raising may take an hour or more.

In 1946, the Parsons and Marine Engineering Turbine Research and Development Association (Pametrada) produced the complete working drawings of a 3,500-shp marine gas turbine, complete with manoeuvring couplings and speed reducing gear, to operate at 85 rpm. This design was intended to give reasonable efficiency in the engine-room of a single-shaft 10,000-dw tanker at 12 knots. The maximum turbine-inlet temperature was fixed at 1,200 deg F to give a working life of 100,000 hours, apart from a few minor components.



Ash corrosion test rig is used to attack the problem of vanadium oxide after combustion of residual oils.

This set has been running for some years at the Pametrada Research Station, Northumberland, a hydraulic brake being used to absorb and measure the power. It could with minor modifications be installed on a merchant ship, but it has proved far too valuable as a research tool to be sent to sea. Moreover, so much has been learned from its development and operation that Pametrada is now in a position to put forward much more advanced designs.

Land-based industrial gas turbines have successfully been run on pulverized coal, but this presents obvious difficulties at sea. A natural alternative would appear to be residual fuel oil. There is no difficulty in burning residual oils in a gas turbine, but the products of combustion give rise to serious fouling and corrosion. Nearly all residual oils contain a very small proportion of vanadium and after combustion vanadium pentoxide is present in the residual ash. This ash is harmless at moderate temperatures, but at normal gas turbine temperatures it becomes sticky and clogs the turbine blades. In the region of 650 deg C it becomes molten, in which condition it is highly corrosive. The rate of attack is rapid and increases with temperature.

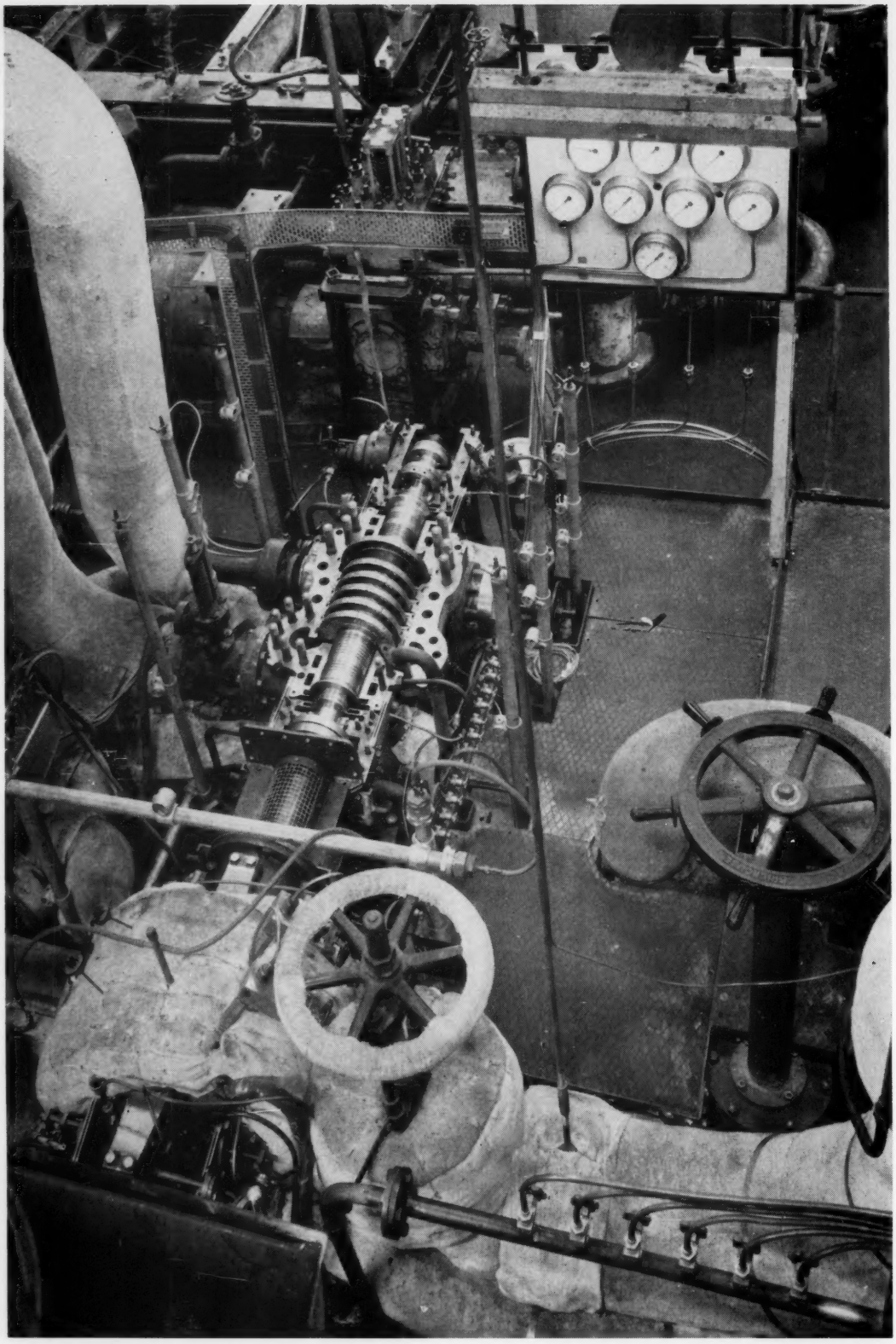
These corrosion and fouling problems are at present the most critical obstacles to the commercial development of marine gas turbines. Pametrada and other research organizations are therefore devoting considerable attention to their solution and there are grounds for believing that these troubles are not insuperable. The main line of attack is the addition of compounds to the fuel, or to the gas stream at the combustion chamber, that have the effect of rendering the ash nonsticking and noncorrosive.

Rotating blades require cooling

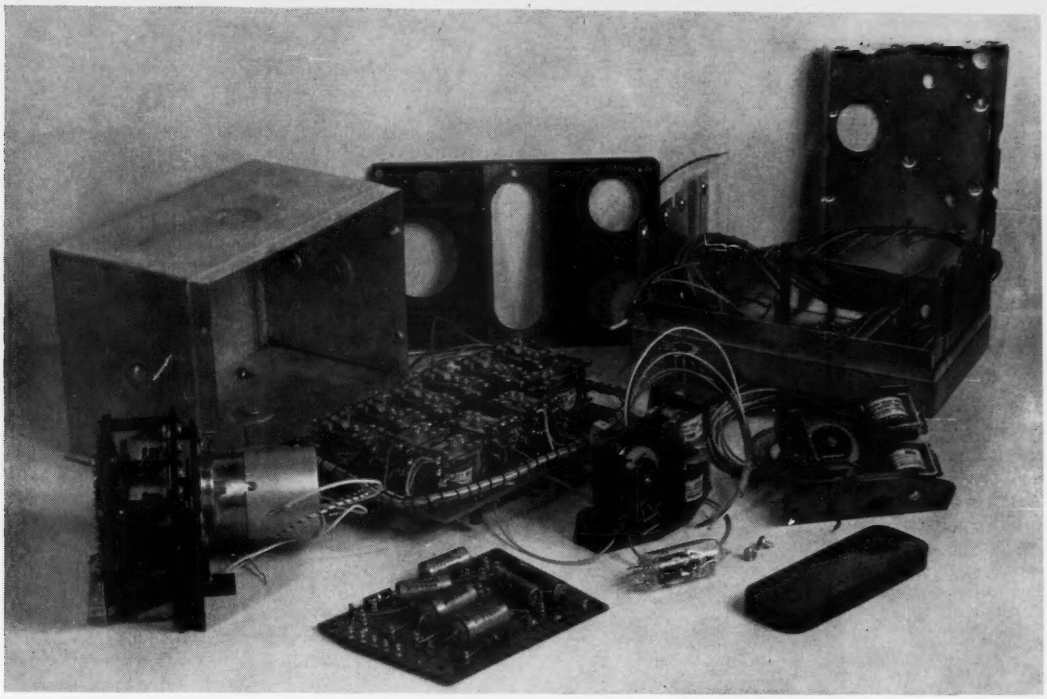
Further development in the gas turbine field is centred on the use of higher gas temperatures in order to increase the over-all efficiency. Progress in this direction depends on the availability of metals and alloys with the required properties for long-life application. The use of really high temperatures—1,000 deg C and upwards—appears to necessitate some form of cooling. The development of cooled gas turbines also offers the attractive possibility of using cheaper low alloy steels.

Among the most highly stressed components are the rotating blades, which are also exposed to the highest temperatures. Much research is therefore being undertaken into the cooling of blades. In one method, known as "sweat cooling," the blade is constructed with a porous skin, so that if cooling air is led to the interior of the blade it will escape through the pores in the metallic covering and in so doing cool the outside of the blade. Another method is to have a liquid coolant circulating inside a hollow blade, the heat being removed by conduction through the blade material.

(Continued on page 57)



High temperature steam turbine, above, may take hour or more to reach full output. Gas turbine takes minutes.



Parts of de-icing controller are shown. Entire detector works on pressure differential, is going into CF-100s.

PSC Engineers Automatic Ice Detector

New system watches for icing of both engine intake and airframe, starts de-icing with heat to add even greater safety to aviation

J. M. BRIDGMAN

MAN. DIR. PSC APPLIED RESEARCH LTD.

FROM CANADA, the world's first fully automatic aircraft de-icing equipment has now come. It was engineered by PSC Applied Research Ltd., under license from the National Research Council.

The system watches for icing of both engine intake and airframe then starts de-icing (with heat) when it detects any. So aviation, already setting high safety standards, is going to be safer yet. PSC's system has been tested operationally by the RCAF and found good. It is now going into the CF-100—Canada's front line all-weather fighter.

The latest version of the detector is the mark 8. It works on a simple pressure differential system.

The detector unit has two probes which project through the aircraft's skin into the slip stream; they extend from a sealed housing which holds a pressure sensitive switch. One probe does the detecting, the other is a continuously heated pressure reference.

The detector has four (pressure) holes aligned along its front face, two (suction) holes to the rear. This means the slip stream sweeps into the probe faster than it can escape and so builds up a greater-than-atmospheric pressure inside.

The other probe also has holes front and rear, but in this case there are four to each face and they are all the same size. So, while pressure in this probe is also higher than atmospheric, it is less than the pressure built up in the detector probe.

But when ice forms on the detector probe it blocks the forward facing pressure holes without reaching the suction holes at the rear. So the pressure starts to drop. When it drops below the pressure in the heated probe it moves a diaphragm and an electrical contact is made. Now a heater in the detector probe is energized, a warning lamp shines and an icing signal is sent to the de-icing equipment.

When the heater has melted the ice from the detector probe holes the inside pressure builds up again, the diaphragm switches off the current to the heater and other circuits—and the cycle is complete.

The process repeats automatically each time ice forms on the detector probe; this means that electrical impulses are sent out by the detector as long as the aircraft is in icing conditions. From these impulses it is easy to judge the seriousness of icing conditions—the faster they come the worse the conditions will be.

The two probes are each 3 in. long and 5/16 in.

in diameter. The detector probe holes are small enough to be sensitive — but large enough not to be easily blocked by dust. The lower rear suction hole also acts as a drain for water which might accumulate; if somehow it should clog with sediment, the upper hole will still operate the detector. Both the rear holes are protected by a deflector guard which prevents melting ice from flowing around to the rear face and freezing over.

The reference probe will never ice up since heat is applied to maintain its temperature above 32 deg. F. So, pressures inside it are always relatively high. Both probes are protected from overheating by internal thermostats. The detector and reference probes are connected pneumatically to each side of the pressure switch diaphragm. The side of the diaphragm connected to the reference probe has a pressure applied which varies only with the speed of air striking the probe surface. The other side of the pressure switch connects to the detector probe, and so the pressure on this side is normally greater than on the reference side. This distorts the diaphragm toward the reference pressure side. In icing conditions, the pressure on the detector side goes negative during the period that the probe is iced over. But the reference pressure remains unchanged, so distorting the diaphragm toward the detector side during the iced period. A sensitive switch is attached to the diaphragm and closes and opens contacts at each position of the diaphragm.

One specially interesting design feature is that the pressure switch will not distort enough to close the icing signal contacts until the air speed past the probes exceeds 60 knots. This means there is no need to switch the instrument off after landing or during run-up.

The electro-thermal de-icing system makes use of the fact that if enough ice is allowed to accrete, it is only necessary to break the bond between it and the airframe and the slip stream will blow it away. This system is very economical in heat. Only enough ice need be melted to break the bond and no water is formed to run back and freeze parts without icing protection. This economy of heat makes it possible to use electrically heated de-icer pads which normally are installed along such surfaces as the leading edges of the wings and tail structures. To be sure that the slip stream blasts under the ice to blow it off, a "parting strip" must be kept clear of ice along the leading edges of all de-icer pads. Then the ice parts and falls away, from both above and below the edges, when the de-icer pads are heated.

The parting strip has to be heated continuously from the first sign of ice until icing conditions have cleared. To watch for overheating of the parting strip in moderate conditions, a temperature sensing element controls the power supplied to the strip and so automatically controls the temperature. But some small amount of ice will have formed before an icing signal comes from the detector; so the temperature of the parting strip has to be raised for the first few seconds to melt it off.

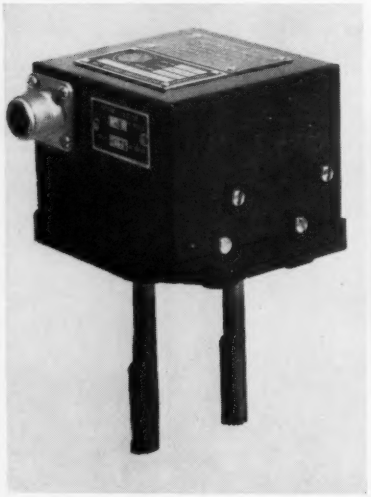
The fact that it takes just a few seconds to break an ice bond, yet may take several minutes to build up enough ice for efficient shedding, means that a further economy of power is possible. By dividing parts of the airframe needing ice detection into a number of shedding areas, power can be cycled from one area to another. So the amount of power required at any given moment can be reduced. The Type T260 detector measures the amount of ice that has formed, as each signal from the detector represents a discrete thickness. By counting the number of impulses from the detector, it is easy to tell when sufficient ice has formed and so when to turn on the de-icing shedding areas. The controller must be designed in such a fashion that it accepts signals from the ice detector and, after counting a preset number of them automatically, cycles the power from one shedding area to another, as enough ice forms on each area.

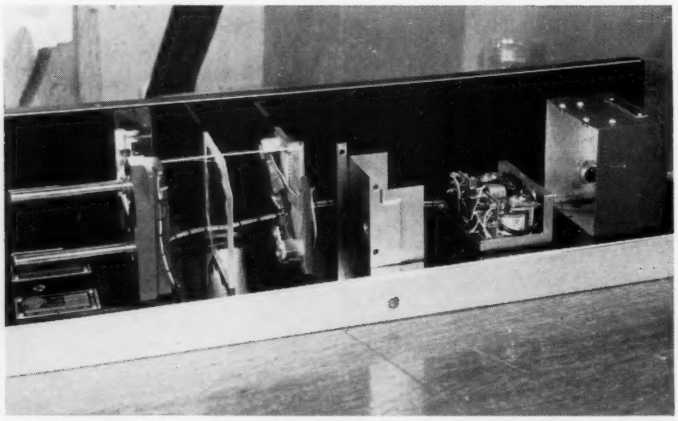
Size and weight created problems

To design a fully automatic controller with a "memory" was not difficult in itself. But the problem was complicated by size and weight limits and the need for ruggedness and reliability. Hermetically sealing the complete controller was partly the answer but this in turn was complicated by the need for all signals and times to be externally adjustable.

The ice detector faced its designers with many unique problems. Some of them are worth detailed mention.

The pressure differentials involved are very small; so the pressure switch must be very sensitive, making one circuit and breaking the other with a pressure differential of 1.5 in. water. **(Continued over page)**





Left, assembled ice-detector is pictorially compared with the same unit disassembled, right. Note probes and pressure holes.

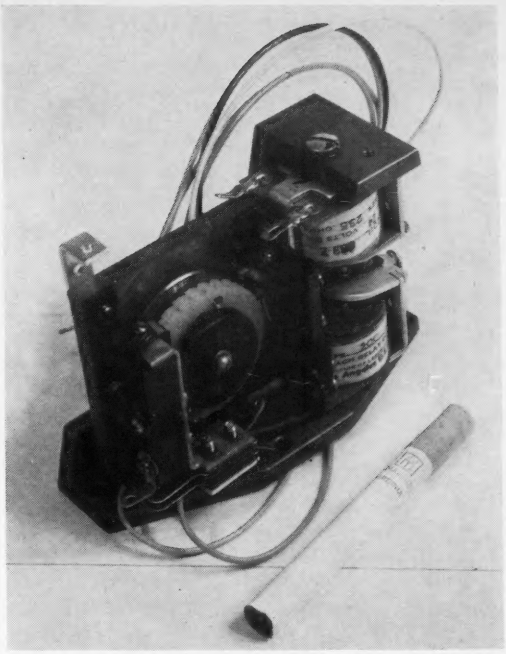
Ice detector *(Continued)*

Despite this sensitivity, it must also be capable of withstanding operational ram pressure of 3.5 psi and tests at 7 psi. And it must be capable of controlling currents as high as 10 amperes. The calibration must remain constant to within 0.5 in. of water over a wide range of temperature, vibration and shock conditions. The probes must be accurately made to be sure of proper pressure factors, must have a high capacity (200 watts) heating element built into them to cater to the most adverse cold conditions, and yet must be protected against overheating and burnout if turned on when the cooling conditions are not sufficient to dissipate this amount of heat. They must be made entirely of non-corrosive materials because they are exposed both internally and externally to the elements.

So the probes were designed with a monel metal core on which a heavy duty heater element was wound. An outer sheath of monel metal was slipped over this and the two bonded together with an epoxy-resin compound. The main housing was cast from aluminum and machined to take the two probes in positions that made access to the pressure diaphragm easy.

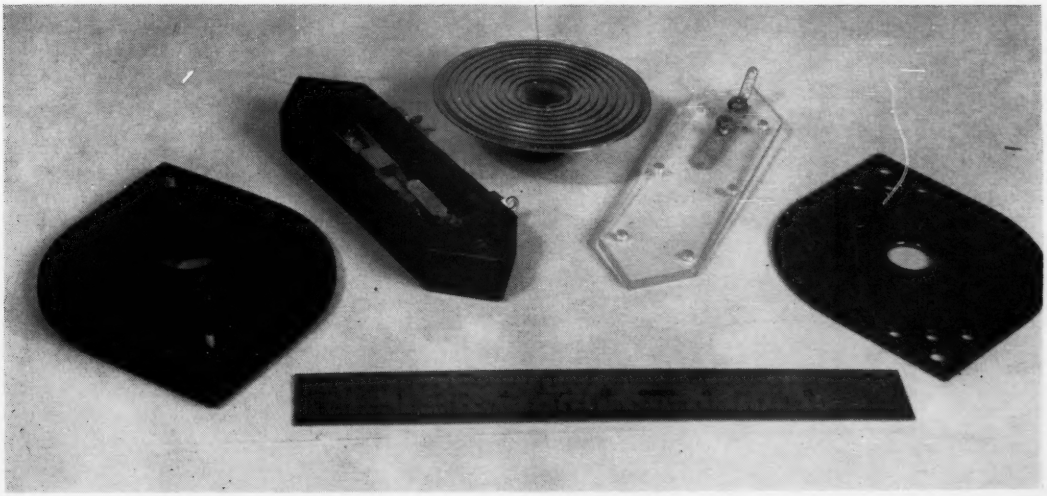
No pressure switch with the right characteristics was available and so a new one had to be designed. Because of the low pressure differential involved designers had to use a relatively large diameter and a very thin material for reasonable deflections. To allow for the high working pressure, this diaphragm was trapped between aluminum plates which limited travel and distortion. Beryllium copper 0.0125 in. thick was selected as the diaphragm material, and after many experiments with the die shapes, a pressure diaphragm was designed to meet the requirements.

With such low pressures available from the diaphragm, it was obviously impossible to provide heavy enough contact pressure to carry currents of 10 amperes. So an interlocking, holding, relay circuit was developed which ensured that only momentary currents, of milliampere rating, were carried through the contacts. This circuit also prevents burning of the contacts through slow make and break, and from vibration and shock. To protect further against vibration and shock, the whole contact and diaphragm assembly was counterbalanced. The relay package was also hermetically sealed. Apart from critical control of materials and construction techniques, which of course is essential, it was obvious that the best approach to maintaining calibration was to get large diaphragm movements for the small pressures involved. The design of the pressure diaphragm was complicated by the need for at least 0.030 in. travel for the 1.5 in. water pressure differential. This was met by the use of the large, very thin, diaphragms mentioned.



The de-icing controller step switch of new Canadian ice detector system is compared with a cigarette.

The obvious solution to the temperature control problem was the use of *(Continued on page 59)*



Pressure switch capsule, contact assembly, size shown here, react after air speed reaches 60 knots.

DESIGN IS THE PRODUCT

judge products from

Chrome trim and fancy paintwork is no substitute for good design which must measure up to four broad requirements

By SID BERSUDSKY
INDUSTRIAL DESIGNER

ABOUT THE AUTHOR

SID BERSUDSKY TOOK his early training in Canadian art and design schools. Newspaper and advertising design work followed—which led him to his present product design practice. He has been reassuringly successful during the 15 years that his practice has run; many consumer products now on sale in Canada were conceived and steered through to production by the Bersudsky office. Sid Bersudsky is much more than a stylist—he has a broad experience of production processes and modern materials. He is a past president of ACID and the only Canadian member of the American Society of Industrial Designers. He is also a Professional member of the Society of the Plastics Industry and a member of the Canadian Government Specification Board. Sid Bersudsky is well known as a keen campaigner for properly integrated design—design which goes beneath the surface to embrace the whole product.

PRODUCT DESIGN is generally judged from four viewpoints:

BEAUTY, UTILITY, PRACTICABILITY, LOW COST.

These four factors seldom coincide in a single piece of work. If a product is not beautiful it is excused on the ground of being cheap; if not cheap, it is excused as being durable; if not practical, it is perhaps beautiful. It seems then that the only way to resolve these contradictions is to find one criterion which will do for all. This criterion is human well-being. The other factors may be left to personal likes and idiosyncrasies of consumers, manufacturers, designers and retailers, so long as these do not impair the essential criterion.

The vulgar chrome ornamentation and meaningless areas of bright metal that overload our automobiles and appliances, do not by the wildest stretch of the imagination contribute to human well-being.

This haphazard attempt to capture markets by sheer weight and dazzle does not contribute to a product's function. It costs more money to produce and the dubious beauty of the end result is frequently extolled only by the advertising copywriter.

Very often the chrome trim, two- and three-tone paint jobs and large gold emblems misrepresent and hide the fine mechanical craftsmanship underneath. The tremendous waste of energy and materials is particularly evident in traffic jams in any large city—

"The tremendous waste of energy and materials is specially evident in the traffic jams of any large city."

PICTURE BY MILLER

four points of view

thousands of long and longer cars, bumper to bumper, creeping along at about 20 mph on horsepower designed to race along at 100. These chrome-lined products (not designed in Canada, I hasten to add) generally carry one passenger intent on getting home in a hurry. Our large automobile and appliance corporations could spend less money on chrome and paint. They could couple creative imagination and the many new technological developments to produce better and less expensive products for a consumer market that is rapidly reaching saturation.

Some Canadian manufacturers mistakenly believe that it is much easier and safer to copy U. S. product designs. They claim that it is much more economical to save design and development costs by the "Me Too" formula. The technique is very simple:

1 Take a trip to New York.

2 Go to any large department store.

3 Buy samples of products you intend to make.

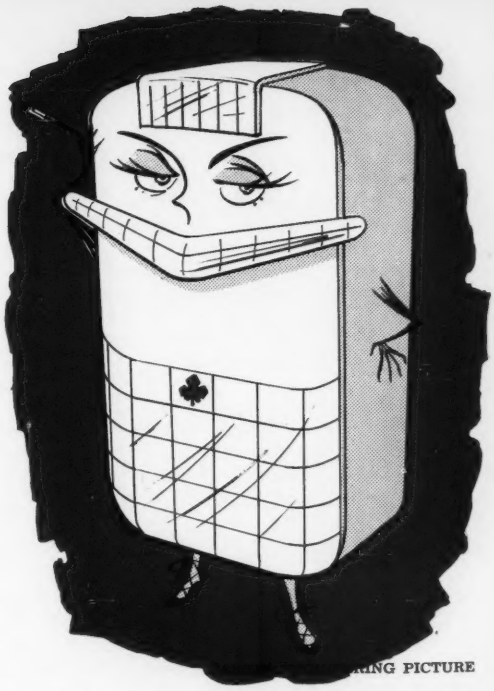
4 Copy the product your wife likes best.

Here is a case history of a mythical Canadian refrigerator (or it might be a washing machine, toaster, or other product). The assistant sales manager shopped the U. S. market and bought several brands of U. S.-made refrigerators. These samples were measured, taken apart, examined, and put together again. Carefully preserved, they were left alone in the factory and some months later a "Canadian" refrigerator turns up on the doorstep. It is complete with gold name-plate, silver maple leaf and a Canadian Merit Award!

All design and development costs are thus saved. The Canadian manufacturer used his own drafting department only to "adapt" U. S. designs.

Photographs of this faintly illegitimate offspring are taken. The advertising agency begins to beat the drums, salesmen and dealers are alerted, the production line starts up in a blaze of glory, the president gets the first unit (gold plated for the occasion) — and another product is ready for the Canadian market.

The Canadian consumer is slightly bewildered by the size and glitter of this juke box that preserves



...ING PICTURE

The 'me-too' formula. "A Canadian consumer is slightly bewildered by the size and glitter of this juke box."

food. In addition to being a shade too gaudy for Canadian tastes, this refrigerator sells for more money than some other domestic and imported models.

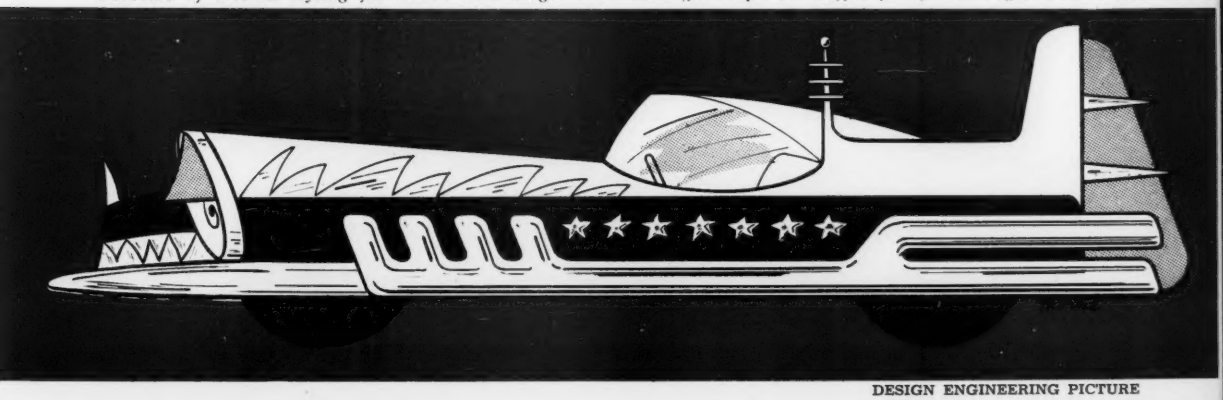
The lagging sales curve is blamed on the advertising agency ("let's get a new one"), the sales manager, ("let's get a younger one"), the production engineer, ("let's get an American"), cheap U. S. imports ("let's blame the Government").

The president of the company takes a brief to Ottawa — no dividends are declared — company stock is down—workers are laid off and union and management are at it again.

So you see it is easy to copy U. S. designs. An assistant sales manager and a couple of draftsmen is all you need.

But when a large Canadian business starts believing

Forecast of Detroit styling for 1957. The longest-ever look (for superior traffic jams) and sugar cake trim.



DESIGN ENGINEERING PICTURE

that it can match competition by mere copying and adapting instead of meeting Canadian consumer needs, it is vulnerable to public disfavor.

Not all is lost, however. Enlightened management in ever-increasing numbers is becoming aware that good Canadian design can help, not only in the domestic market but in the export field as well — Canadian designed and developed products are finding an increasing and receptive market abroad. The day is not far off when the slogan "made and designed in Canada" will help us to our fair share of world trade. The potentials are here. It is up to all of us working together to make it happen.

I am frequently asked a number of pertinent and sometimes impertinent questions about industrial design. I have collected some of the most interesting ones and will try to answer them here:

Questions I am asked

Question: What is industrial design?

Answer: Good industrial design is the sum of the designer's experience. It results from the ability to analyze and solve problems by organized thinking and imagination. Industrial design is the sum of five parts: convenience of use, ease of maintenance, economy of manufacture, safety, and that intangible combination of line, form and color, all equally vital to a product's success. Industrial design is a human thing concerned with human beings, their comfort, emotions and preferences. Man-made design seeks appropriate means to bring functional ease, good looks, lower costs, to useful objects. Good design keeps the user happy, the manufacturer's factory humming and the retailer busy.

Question: What percentage of product designs are based on an actual check to see what the consumer wants? One industrialist has criticized the slogan "good design will sell Canadian products," suggesting research into consumer desires would be better.

Answer: Good design is selling Canadian products. Any good design is one that has public acceptance by virtue of its function, cost and appearance. In order to attain maximum product acceptance, research regarding consumer tastes and trends must, of course, be conducted. No competent industrial designer would think of sitting down and drawing a pretty picture of a product and calling this a finished product-design. Generally he works on a co-operative basis with the client's engineering, production, advertising, sales and management executives. After the basic requirements of the design projects have been established a great many of the design solutions become apparent. Then, and only then, is the designer in a position to check consumer acceptance. This is done by means of prototypes and is not a guarantee of market acceptance but it does answer some of the questions that have cropped up.

Question: Just how closely does good design, from an artistic and functional standpoint coincide with design that sells? Has not someone said that a store must have 25% of its goods in distinctly poor taste?

Answer: Tastes differ greatly. What may be a good design to some, may prove entirely unacceptable to others. The competent industrial designer when working on a design project always tries for a design that will appeal to the greatest number of people. It may not be a suitable design to exhibit in the museum or the art gallery—but museums and art galleries do not constitute the buying public. If the design project (say a refrigerator) performs its functions well, sells competitively, is more attractive than the competitor's in its immediate price group and appeals to Mrs. Jones, then it is a good product design.

Question: How much of good design depends on training? Might not an untrained individual turn out work superior to a person who took a lot of courses but did not have equal talent?

Answer: Good design depends a great deal on observation of consumer tastes and trends. Obviously this can come about through experience only. Since an industrial designer must be familiar with many factors which contribute to good design, training in such fields as engineering, merchandising and the theory of design are very helpful. This elusive and intangible thing called "talent" for industrial design does not necessarily mean top grades in a design school. To me it means the ability to get along with people—to like to rummage through department stores—a sincere appreciation of the skill of men and the capacity of the machines that make product designs into reality and to thoroughly understand the problems faced by the consumer, the retailer, and the manufacturer.

Question: When a young Canadian has taken a lot of courses to make him a designer, how can a manufacturer tell if he is a good designer? He can pass examinations in the background subjects but how can a school grade him on ability to produce designs that sell?

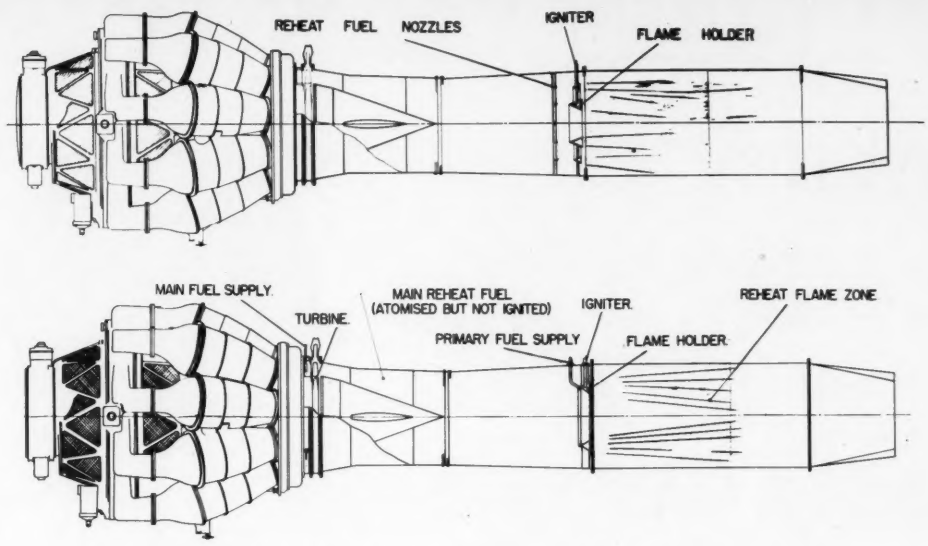
Answer: A graduate of a medical school is not yet a physician until he has served an interne under experienced medical men. A graduate of a law school or a school of architecture must also serve a term of "apprenticeship." It would be a mistake for any manufacturer to assume that a graduate of a design school could produce practical designs that sell, without first serving an apprenticeship period either with some experienced industrial designer, or with a manufacturer's engineering and designing department.

Question: What kind of money does it cost? Is it not beyond the budget of the small manufacturer? Just when does hiring or engaging a professional designer pay?

Answer: Both large and small industries can benefit from the services of an industrial designer. Design that wins acceptance does not happen by accident, nor is it the result of well-meaning, but untrained effort or hopeful guesswork. Furthermore, design that produces results costs money for the very reason that it takes time, knowledge, experience and talent to create. However, this cost is low compared to the staggering cost of design that results in failure.

Question: Why is industrial design not undertaken by engineering and designing staffs of manufacturing concerns? Is it necessary to go outside for talent?

Answer: Staff designed products are issuing from plants every day of the year, but the outstanding commercial successes are the work of specialists in the field. Why? Because the outsider brings a fresh viewpoint. He comes to the problem armed with a broad knowledge of what has been done in other fields. The staff engineer and designer, on the other hand, is often too well acquainted with limitations. Long association has schooled him in what cannot be done and his vision too often has become narrowed. Team work between a consultant and staff designers often brings the best results. ★



Old system of "afterburning" is shown, top diagram, and the NAE reheat system, below.

Canada Displays New Jet Reheat System

Afterburner fuel cools turbine blades before burning, limits engine combustion chamber temperature, doubles thrust, improves performance providing higher speeds, much greater rates-of-climb in military aircraft

BOOSTING THE THRUST of jet engines by burning additional fuel in their exhaust jets has been the way that military aircraft have met the continual demands for higher speeds and greater rates-of-climb. This system is known as "reheat" or afterburning. At high speeds it is capable of nearly doubling the available engine thrust.

Reheat system performance has been worked on at the National Aeronautical Establishment at Ottawa for the past four years. As a result of an intensive research program aimed at improving reheat performance, another system has been developed and demonstrated. It differs from the old way in that the reheat fuel, before being burned, is used to cool the critically hot turbine blades, which normally limit the maximum temperature in the engine combustion chambers. This makes it possible to burn more fuel in the engine proper apart from the reheat system, and this in turn improves the performance of the whole system.

The initial NAE program included theoretical studies, small scale test rigs. Full scale static engine tests were carried out mainly by the engine laboratory at the Establishment, while the flight tests, now in progress, are being carried out by the Flight Research Section at Uplands Airport, Ottawa. The flight tests are an essential part of the development of the reheat system since the reduced pressures at high altitude generally have an adverse effect on the efficiency of the combustion processes.

On January 14, 1955, the first test flight was made using the new NAE system. It marked the first time that a Canadian designed and built reheat system had been airborne. Since then, altitudes of more than 40,000 ft have been reached during the test program, which is worked out in conjunction with the CEPE (NAE) Detachment of the RCAF stationed at the Flight Research Section.

A Gloster Meteor F, Mk. IV, on loan to the National Research Council by the U. K. Ministry of Supply, is being used for the tests.

Increasing consumption of fuel to nearly 2½ times normal, the new afterburner consumes a total of 900 gallons of kerosene per hour in the Meteor's fitted-out Derwent engine. The entire installation weighs only 230 pounds and is believed to be unique in the Western world and is probably unknown in the East. ★

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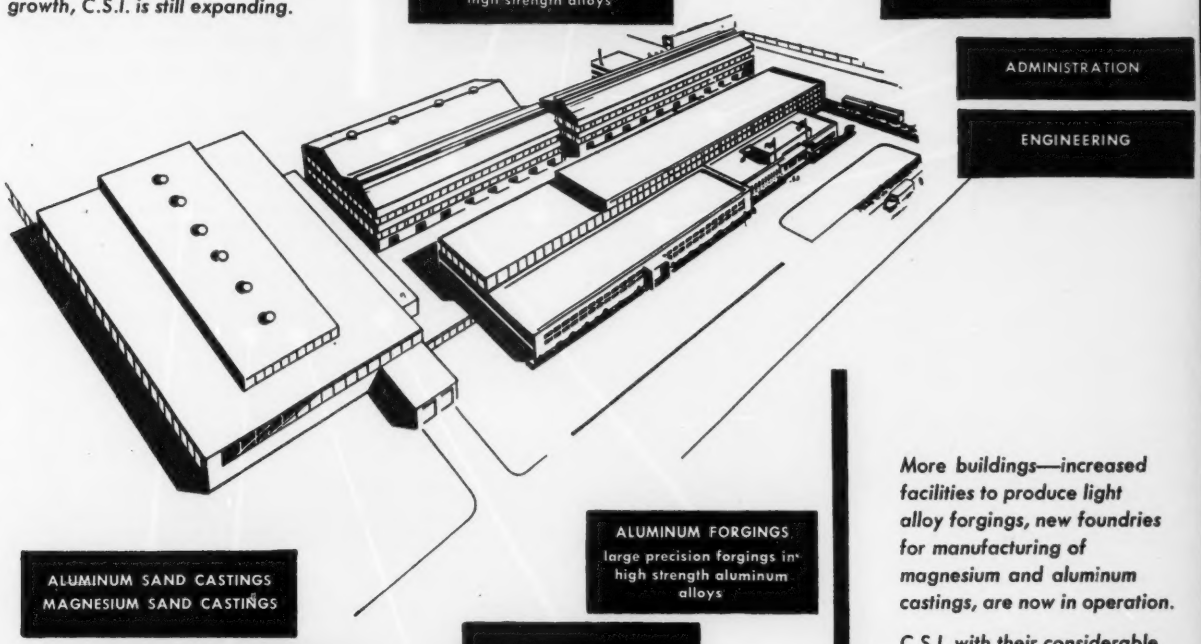

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HORNER AND SECOND AVENUES, ETOBICOKE, ONTARIO.

Heat treatment

(Continued from page 44)

to a less amount of solute in solution.

Castings that are used in applications involving elevated temperatures or extremely close machining tolerance may require a stress-relieving and degrowthing treatment which involves heating the casting at a temperature of 280 deg C (536 deg F) for 10 hours.

Ingots of the heat-treatable wrought alloys in the "as cast" state have their constituents distributed heterogeneously in rather large particles. To provide a more uniform distribution of the soluble constituents and to facilitate fabrication, these ingots usually are heated to the solution heat-treatment temperature, or slightly higher, held at this temperature for 8 to 16 hours and then cooled slowly.

Heat-treating furnaces fall into two general classes. The air furnace, in which heated air is circulated around the work, and the salt bath containing molten salts in which the work is immersed. Both types of furnace may be heated by electricity, gas, oil or solid fuel, and the range of designs or sizes is almost limitless. The exact requirements depend on the nature of the work.

Forced-circulation air furnaces, either electrically heated or fuel fired, are used generally for the heat treatment of aluminum. Electrically heated furnaces are preferred to fuel-fired types because of their superior temperature uniformity, ease of control, and clean atmosphere in contact with the metal. Furnaces heated by gas, fuel oil, and other combustible materials should be of the indirect or radiant-tube type wherein the products of combustion do not come in direct contact with the metal, otherwise high-temperature blistering may occur. Forced circulation of the air in the furnace is necessary to provide a uniform temperature which should not vary more than ± 3 deg C (5 deg F) from the control setting in any part of the working zone. Direct radiation should be kept to a minimum by the use of suitable baffles.

Heat-treatment furnaces for aluminum sheet are of the overhead or horizontal chamber type with a quench tank situated in front of or directly underneath the furnace. On the other hand, castings and forgings are usually heat-treated in pit-type furnaces. In this case the quench tank is situated alongside. Here in Canada, tubing and extrusions are heat-treated in vertical cylindrical furnaces located above ground with the quench tank directly underneath. On completion of the solution heat treatment the door is opened and the material allowed to drop quickly into the water below.

Continuous heat-treating furnaces, equipped with special baskets or racks, have been used to advantage in the quantity production of forgings and castings. Each time a basket is charged into the furnace, another is discharged into the quench tank located at the rear.

A salt bath furnace is essentially a container in which salts are maintained in a molten condition at the desired temperature. The tank may be of cast iron or welded steel, but "Armco" iron of very low carbon content and high-grade boiler steel, are to be preferred by virtue of their higher resistance to attack by the salts. The tanks are usually enclosed in an insulated outer shell which in turn may be installed over a pit as a precaution against failure of the inner tank. There are several means of heating—radiant tube, external gas or oil firing, electric immersion heaters—all are in general use, but the electric heaters are preferred. As with air furnaces, the temperature within the working zone of the bath must be maintained with ± 3 deg C (5 deg F) of the controlling temperature. This is essential if the materials are to be treated uniformly. Suitable salt compositions include pure sodium nitrate, a eutectic mixture of sodium nitrate and potassium nitrate, and several proprietary salt mixtures containing sodium and potassium nitrates and/or nitrites. Such mixtures are more expensive than pure sodium nitrate, but have lower melting points and are thus more fluid at heat-treating temperatures, consequently reducing the drag-out loss. Some of these mixtures provide a sufficient range of temperature over which they are fluid, to allow, if desired, aging and annealing as well as solution heat treatment to be carried out in the same bath. When salt bath furnaces are being used for solution heat treatment a suitable quench tank must be located close to the furnace.

Rapid quenching from the solution heat treatment temperature is necessary to obtain maximum mechanical properties. The proper method of quenching aluminum alloys is by total immersion in a tank of cold water, kept at temperature of 20 deg C (68 deg F) by a continuous flow of clean water. Quenching should not be done if the temperature is over 30 deg C (86 F). The transfer from the furnace to the quench tank should be as rapid as possible; transfer times of considerably under one minute are commercially feasible.

Castings and forgings in certain alloys should be quenched in water ranging in temperature from 60 deg C to 100 deg C (140 deg F to 212 deg F). Quenching in hot water reduces warpage and distortion as well as the residual stresses which may manifest themselves later.

Spray and air blast quenching have been introduced by some manufacturers to minimize warpage and distortion during quenching. However, these methods are not as rapid as complete immersion in cold water and best mechanical properties may not be obtained.

Aluminum products that have been treated in salt baths must be given a final wash in clean water not over 60 deg C (140 deg F) to eliminate every trace of the heat treatment salts, which may cause chemical attack. This washing should follow immediately after removal from the quench tank. ★

Steam turbines

(Continued from page 46)

The liquid coolant method depends on the fact that the blades are rotating. It cannot, therefore, be used for the fixed blades, which are not so highly stressed anyway. A possible solution is to make the fixed blades of refractory material. An operating temperature of 2,200 deg F is well within the capabilities of many refractories, but a difficult problem is presented by thermal shock. Because of their brittleness, refractory materials are liable to crack and split if the gas temperature is changed suddenly. Pametrada is therefore submitting refractory materials to severe thermal shock and studying the effects.

The Association is now actively engaged in the development of an experimental single-stage turbine for high-temperature operation. It is proposed to cool the moving blades and rotors, while the fixed blades will be made of refractory material.

The present trend in steam turbine development is toward the use of higher pressures and temperatures, but the potentialities of this line of development are again dependent on the availability of suitable materials. At present the highest steam temperatures used at sea are about 1,000 deg F at superheater outlet. If these temperatures continue to rise, it will become necessary to consider the use of austenitic steels for such components as blading and superheater steam pipes. Their application in superheaters leads to the problem of welding these steels both to themselves and to the ferritic piping which occurs outside the superheater.

Pametrada has designed and is now testing a six-stage impulse turbine, which represents the high temperature portion of a three-cylinder turbine developing about 3,000 shp. The main objective is to gain experience in the use of high pressure and high temperature steam. The turbine has three different materials for its first row of blades, namely G18B, Nimonic 80 and FDP. The casing is FCB.

The power is absorbed by a steam brake consisting of a two-stage astern turbine, which uses steam exhausted from the driving turbine. In order to lower the temperature to a figure small enough to allow the steam to be condensed in a surface condenser, a desuperheater, consisting of six water sprayers, is fitted in the exhaust line. The boiler delivers steam at about 1,200 psi and 950 deg F. To superheat the steam up to 1,100 deg F a separately fired second stage superheater is used. The speed of the set is 8,900 rpm. ★

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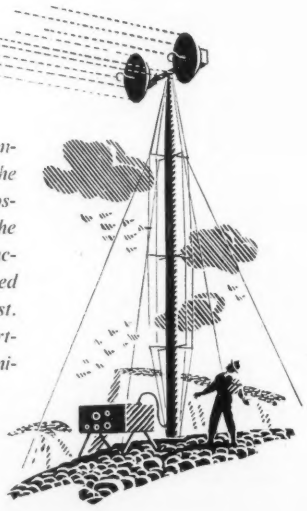
Some illustrations of the scope of Marconi research:

MARCONI RESEARCH *developed the Electronic Lamplighter—to switch individual street lighting units on or off*

automatically, according to the amount of daylight. This can make substantial savings in cabling and switchgear, and has applications in industry, aviation, etc.

MARCONI RESEARCH *is completing development of the Geodimeter — to make possible, for the first time, the accurate surveying of inaccessible areas photographed from the air, at low cost. (Developed for the Department of Mines and Technical Surveys.)*



MARCONI RESEARCH. *Under development is the Electro Hydrometer — to measure water levels from any remote point. This will reduce costs, maintenance difficulties and emergency installations in all types of industry, logging operations, municipal sewage and waterworks.*

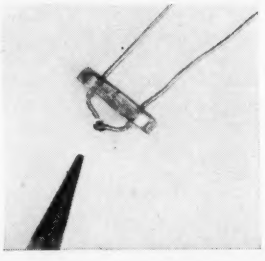
Time is valuable. Telephone Marconi's Research and Consulting Department, collect, to discuss your problems in a personal conference. Telephone number is: **Montreal, VICTORIA 3627.** *Ask for Consulting Service.*

Marconi CMC CANADIAN MARCONI COMPANY

CANADIAN MARCONI COMPANY MONTREAL 16, P.Q.

Canada's Largest Electronic Specialists

MARCONI RESEARCH *work on Ferroelectric memory devices promises significant advances in the development of new electronic computing and data processing equipment which is of such fundamental importance in the fast growing field of automation.*



Ice detector

(Continued from page 49)

thermostats, but one small enough to mount in the probe, and yet capable of carrying the high current, was not available. This problem was met by using a glass-mercury thermometer with sealed-in contacts which work the relay circuits rather than directly into the high current circuits. Because of their fragility, investigation is still going on into better forms of temperature control for the probes. Careful jig and fixture design made accurate probe hole positioning possible. The positioning and the hole size were first determined from extensive wind tunnel tests.

Some of the engineering and production problems that came up with the de-icer controller were quite new. Two timing intervals in the order of seconds to minutes had to be provided—and these had to be externally adjustable in discreet steps despite the fact that the unit was hermetically sealed. Then, some way of counting impulses from the detector had to be incorporated so that after a definite number of impulses had been picked up, the ice shedding sequence would be started. And the number of impulses had to be adjustable from the outside.

Besides these design demands, provision had to be made for all circuits to restore themselves to zero should the power be turned off during a sequence—by the aircraft landing, for instance.

A case-size target of about 5 in. by 5 in. by 8 in. and a weight of 12 lb. was set. The final result was 4¾ in. by 5⅝ in. by 7½ in. with a weight of less than 10 lb.

Hermetic sealing of a can this size without the use of heavy materials, or cylindrical construction (with consequent increase of space requirement) was a real problem as internal pressure as high as 10 psi might be met in flight and a test of 24 psi was desirable. This was solved by an ingenious bulkhead and screw arrangement that ties the centre of each face to the centre of the opposite face, without interfering with the ease of assembly. A "coffee-can" type of final

(Continued on page 64)

Quotes

Points from current papers and speeches

A PAPER READ BY ROY V. JACKSON at the annual meeting of the Patent Institute of Canada in Montreal, September 30, discussed Canadian dependence on foreign product design and how it weakens our development by passing up our own abilities and distinctive resources.

More original Canadian design, he said, would mean increased vitality in Canadian industry, stronger resistance to foreign control, better products for Canadian users. But one good reason for the reluctance of our manufacturers to invest in independent Canadian product design is the lack of good legal protection against design piracy, he added.

"There are two kinds of creativeness in industry, creativeness in ideas, which is invention and may be patentable, and creativeness in the carrying out of ideas, which is design. Even with a good new basic idea (such as the idea that was embodied in the first safety razor) the designing work that goes into the carrying out of the idea is more directly responsible for the quality of the product than is the idea itself. But usually there is no really new idea involved, and the problem is to design a **better** version of an old product. Then the design work is the **only** factor in the quality of the product. So the difference between a good product and a bad one always involves an investment in design, and it is this investment that design law can and should protect from unfair appropriation," patent attorney Jackson declared.

What we need is a design law, he asserted, that assures every manufacturer that an investment in original design will benefit him and not his competitors. And it must not discourage the creation of other original designs of the same article—it must not interfere with the free use of the general ideas—new or old—that are needed for the creation of original designs. But the so-called design protection in the present Canadian and British legislation is so unrealistic and limited that many people doubt that **any** design law is worthwhile.

"Designing a product is like writing a book. The author's job is to organize words, sentences, paragraphs to express ideas. The words and ideas are free to everyone. But your own organization of the words, your own expression of the ideas, is protected—by copyright law," he went on.

"The designer's job also starts with a combination of ideas. The central idea is the functional idea of the product. It can be as old as the idea of the straight razor, as new as the idea of the latest man-made moon. But this general idea is modified by other ideas—facts, methods, principles—like cost ceilings, consumer preferences, available materials, existing machines. The first question is always: what does the public want? The second is: what is it willing to pay for it? This combination of ideas defines the designers's job."

But instead of words, he said, the designer uses design features like material, arrangement, shape, color, texture to express these ideas in his own way. Throughout the process the designer's personal esthetic sense and good taste controls the final form of the product, just as the author's sense of style and good taste controls the final organization of the book. And he declared, when I say "form" I mean all the specific characteristics from the inside out."

So the problem of protecting design expression, the attorney said, is the same as the problem of protecting literary expression, and copyright, which protects original expression, but not the ideas expressed, is the proper kind of protection for designs.

"Take a new dictating machine that is based on the idea of using a certain circuit arrangement, the idea of using the principles covered by certain patents, and the idea of making the whole thing about the same size as a standard book. Copyright-design protection on this machine would prevent anyone from copying everything that was original in the designer's organization of the design features, including the arrangement of the inner components that made the size and shape possible," he illustrated.

But this copyright-design protection would not prevent another designer from using the same circuit, the same patents, all the other ideas expressed in the device and contributed by engineers, electronic experts, and so on, he continued, so long as he chose the components himself and arranged them himself and designed his own casing to fit the parts.

"In most cases the design process is so complex that it would be impossible to copy the original work without that fact being relatively easy to establish by questioning the copier. Not having experienced the creation of the design, he would have no idea of the real purposes and reasons involved in the various design features."

Copyright-design legislation should avoid using legal language and legal ideas that are not already found in our copyright Act, he cautioned. But we should reduce the long-term of protection that copyright would otherwise give, and we should require registration with clear identification of all protected designs.

Generally speaking, the proper time for these restrictions to apply is when the design is produced by a machine or an industrial process for sale as a finished industrial article, he further reasoned.

Until then, there is no good reason for withholding full copyright protection from the drawings, models or prototypes for the design. But once the copyright owner produced the design for sale by an industrial process, it would no longer be an infringement of the copyright for any other person to produce or reproduce the design as a "finished industrial article."

The only protection for the finished article would then be by registration under the new design act. It would give the registrant the sole copyright to produce or reproduce the design as an industrial article for a term of, say, seven years.

When an application for registration of a design is filed the Registrar should search his indexes for similar published designs and make a record of them in the registration. The indexes should include outstanding designs of various countries, as well as registered designs. The Design Index and files of the National Industrial Design Council should be integrated with the official indexes to make a design record that would be valuable to industry.

"Some form of marking should be required; the principle would be that it is safe to copy in good faith any unmarked industrial article," he concluded.

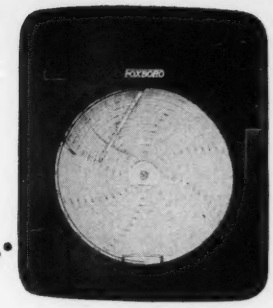
• • •

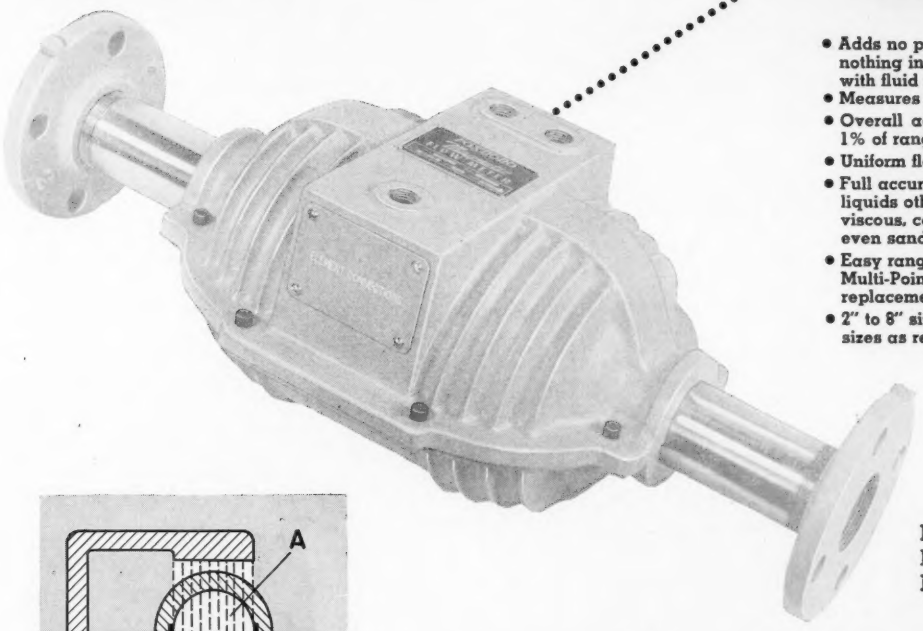
THE DISAPPEARANCE of internal stresses in glass at constant temperature has been discussed by **A. M. Kruithof** and **A. L. Zijlstra** of the Philips Research Laboratory.

It turns out to be dependent on three factors: the viscosity, the instantaneous elasticity and the elastic after-effect. The first part of the article deals with these factors for a certain type of glass.

In the second part, a formula is derived for the disappearance of internal stresses in a rod of stabilized glass at constant temperature, which is suddenly stretched to a specified extent by the application of a constant tensile force. As a result of the mutual effects of viscosity, elasticity and elastic after-effect the resultant stresses disappear. Their disappearance can be described by the sum of three exponential functions. This formula is tested experimentally.

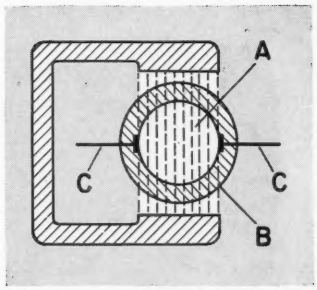
NEW! a flow meter with no flow restrictions!





- Adds no pressure drop — nothing inside pipe to interfere with fluid flow.
- Measures fluid velocity directly.
- Overall accuracy better than 1% of range over entire scale.
- Uniform flow scale.
- Full accuracy sustained even on liquids other meters can't handle: viscous, corrosive, or pulpy — even sand-water slurries.
- Easy range change — either by Multi-Point Switch or range coil replacement, as preferred.
- 2" to 8" sizes standard — larger sizes as required.

FOXBORO MAGNETIC FLOW METER



SIMPLE, TROUBLEFREE, OPERATION

The Foxboro Magnetic Flow Meter operates on the same principle as a power generator. A magnetic field (A) is maintained through a standard pipe section (B) of stainless steel or other non-magnetic material. This pipe section is lined with Kel-F® or other insulating material. Liquid passing through pipe acts as moving conductor, generating an electric voltage which varies in proportion to liquid's average velocity. Flush electrodes (C) in pipe wall "pick up" this voltage which is recorded in desired flow units by Dynalog Electronic Recorder or Controller.

This premium-performance meter measures *magnetically* the flow rate of virtually any liquid except hydrocarbons. It completely ignores such common metering headaches as turbulence, suspended solids, and variations in conductivity, density, and viscosity. It even measures reversing flows.

Installation is simple. The magnetic spool piece connects into the line like any equivalent length of pipe — no seals, purges, meter runs, or straightening vanes required. Connects by 2-conductor cable to remote Dynalog Electronic Flow Recorder.

Maintenance is practically eliminated. There are no pressure taps to become plugged or frozen, no working parts to foul.

Foxboro Magnetic Flow Meters are already in use on such widely different liquids as beer, sand-and-water, rosin size, rock-and-acid slurry, viscose, and highly corrosive liquid detergent. Find out how this precise, troublefree flow meter can help *your* processing. Write **Peacock Brothers Limited, P.O. Box 1040, Montreal 3, Que.**

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New products & components

New materials and tools designed for you

A NEW WRAP-AROUND zip-on protective jacket made of durable 12-gauge Vinylite plastic to cover pipe, cable, duct and conduit insulation, has been recently designed and patented.

Known as "Protektinsul," the new jacket is manufactured in a variety of colors by the **E. T. Sampson Company.** The sturdy covering can be used indoors and out. Requiring no priming or painting, it is flexible, easy to handle and can be installed speedily and economically, requiring little labor.

Prefabricated to individual requirements it simply zips on over pipe and

A Vinylite "wrap-around" plastic coat

duct insulation—thereby eliminating fitting, cutting and sewing. Insulation time and costs, therefore, are reduced sharply.

The closure is an electronically welded vinyl slide fastener which locks firmly into place, forming a watertight, vaportight and airtight joint. End joints, bends and insulated fittings are taped with the same "Vinylite" material as the covering and sealed with a special liquid vinyl sealer to ensure maximum protection. It is non flammable and will not support combustion; it possesses high dielectric strength. (200)

• • •

A NEW PACKAGE, designed, developed and produced in Canada to provide complete protection in shipment and in storage for stainless steel electrodes is now being used by **Air Reduction Canada Limited.**

The package consists of two seamless cylindrical sections of impact-extruded 3S aluminum. The top section (or cap) has an expanded rim which telescopes over the bottom section and is sealed airtight with a waterproof adhesive tape.

Credit for the idea and design of the container go to D. M. Archer, Process Engineer in charge of electrode production at Airco.

The new tubular container, which holds 10 lb of electrodes, can be opened without special tools simply by removing the tape seal and pulling off the cap. Since no metal is cut or removed when the container is opened, it can be resealed by replacing the cap and sealing tape.

A safety feature is that there are no sharp edges because of the soft aluminum used. (201)

• • •

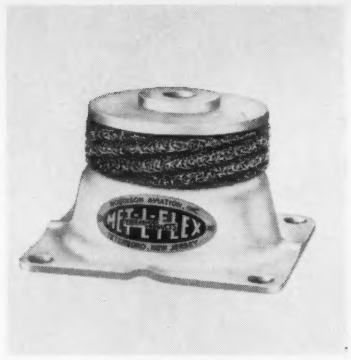
A REVOLUTIONARY NEW AUTOMATION intercommunication system providing two-way "private" conversation between stations without the use of any controls at either station during conversation, has been marketed by the **Talk-A-Phone Company.** (202)

• • •

A NEW ALL-METAL mount, produced by **Robinson Aviation,** has been designed to further control shock, noise and vibration in industry. Featuring an exclusive wire mesh construction, known as Met-L-Flex, the mount is claimed to be superior to rubber style mounts both in life and service.

Applied in such locations as fans and blowers, small punch presses, air conditioning equipment and refrigeration, it is designed to act as effectively when it is suspended from overhead as in the orthodox floor mounted upright position.

Met-L-Flex, an exclusive development



A long life mount

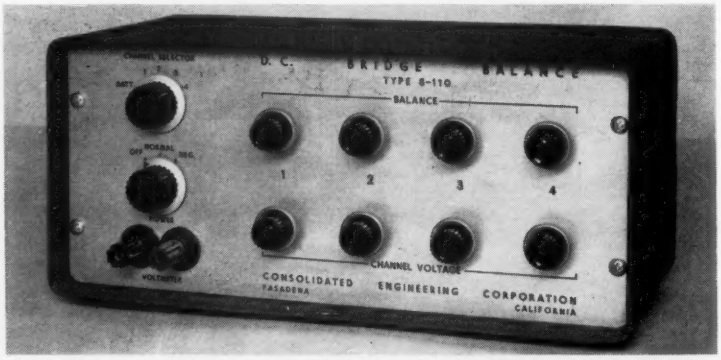
by the company permits unchanged performance in a wide range of temperatures as well as standing up in ordinary deteriorating conditions. (203)

• • •

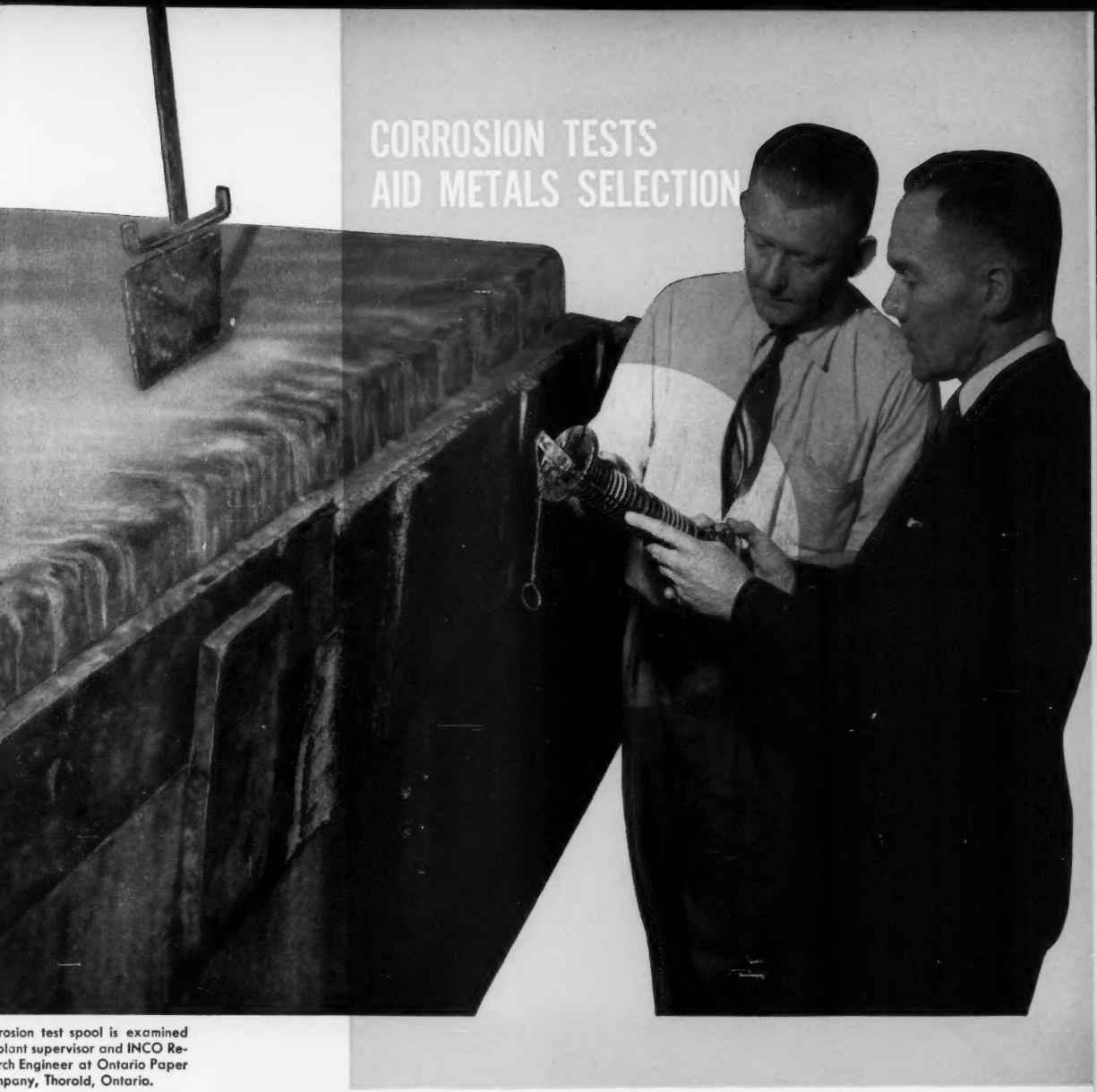
A NEW four-channel bridge balance has been put into production by Consolidated Engineering Corp. Company engineers say that it provides the necessary control link between resistive-bridge transducers and recording or indicating devices such as direct-writing or photographic oscillographs, chart recorders, analog-to-digital conversion systems, and ordinary meters.

The highly flexible instrument is an accessory for use in direct recording of the output of a wide variety of strain-gauges and strain-gauge-type pickups without the use of amplifiers. Design features and controls combine simplicity and a high degree of accuracy for laboratory or mobile use.

Each channel is provided with its own front-panel voltage control, and the channel-selector switch connects any desired channel to the voltmeter circuit. Visibility to adjust voltage individually on each bridge allows pickups of different resistance value to be used simultaneously. The individual sensitivities can be set to the desired value. (204)



Four channel bridge balance to production.



rosion test spool is examined
plant supervisor and INCO Re-
rch Engineer at Ontario Paper
npany, Thorold, Ontario.

Let INCO be of service* to you

The above picture shows an INCO test spool which contains a variety of metals and alloys for testing under actual conditions of projected use. Over many years, INCO has made thousands of "on the job" corrosion tests to determine which alloy or metal is best suited for the particular job. This type of close co-operation enables INCO to put its facilities, personnel and experience to the best use in helping Canadian industry. If you have a metals problem . . . let the information and experience available at INCO be of service to you.

**Information involving corrosion, fabrication, foundry problems, high and low temperature service and metals selection.*

EMBLEM OF INCO SERVICE
TRADE MARK

INCO SERVICE GOES WITH INCO NICKEL
DEVELOPMENT AND RESEARCH DIVISION

THE INTERNATIONAL NICKEL COMPANY OF CANADA, LIMITED, 25 KING ST. W., TORONTO

Ice detector

(Continued from page 59)

seal was developed to allow ease of disassembly and resealing when necessary. A new technique of installing and soldering hermetically sealed Cannon connectors was developed to avoid the risk of solder seal cracking from the weight of the connectors under vibration. A glass view port with a humidity indicator card behind it was incorporated to act as an indicator of leakage of the hermetic seal.

Because a need for quick resetting prevented the use of most other forms of timing devices, a special timing unit using a Haydon 24-volt chronometric timing motor was designed. By driving both timing units from one motor it was possible to save on costs and space. Adjustment was made by means of electrical contacts on the timers.

Standard stepping switches (of the telephone type) were used as counters in experimental work but they lacked the resetting feature required. Since no suitable switch could be found, an entirely new, small size, stepping switch was created. ★

Indium cell

(Continued from page 36)

which were necessary in the mercury system to stop internal short circuits by the reduced mercury. The Elgin cell consequently attains greater electrical capacity per unit volume, since space is used to greater advantage.

The cell's components are set in a mechanical structure that holds them in proper position. It also provides leakproof seals at the cell terminals as well as battery case seams. And a plastic battery case takes only a small fraction of the space required in conventional design. This again increases battery capacity.

Small cells now being produced by the company have a capacity per unit volume, which is at least 25% more than that of mercury cells.

An open circuit voltage of 1.15 volts is delivered by the indium cell compared with the 1.35 volts from the mercury cell. However, by a simple replacement of the cathode material, an open circuit voltage of 1.37 volts may be obtained. This compares closely with that of the mercury cell.

In certain forms, the indium cell may replace the commercial mercury cells and in others make available a lower voltage cell, particularly suitable for transistor circuitry.

Superior to other cells in capacity per unit volume of space, the indium cell is fully dependable in service. ★

Would you like further facts about advertised products in this issue?

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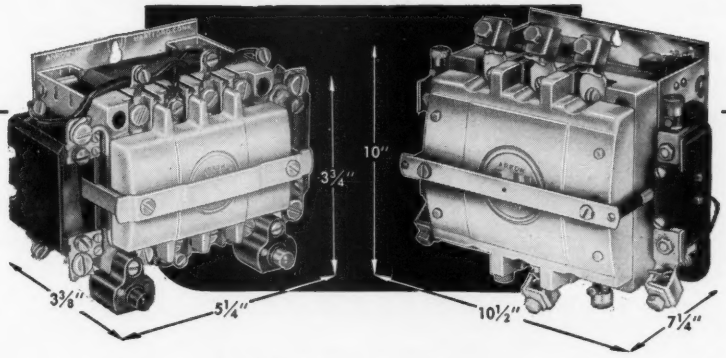
more big features

IN JUST 1/2 THE SPACE



SIZE O
Enclosure Dimensions:
6-11/16" x 6-3/16"

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Enclosure Dimensions:
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TYPE "RA" MAGNETIC STARTERS

Whatever your requirements in a motor starter, you'll find the **right** unit to do the job **better** in the complete Arrow-Hart line, available in all sizes, 0-1-2-3-4. Straight-thru front wiring exclusive with A-H means **easy** wiring, easy servicing, easy mounting. The patented A-H **"RA" design** cuts conventional starter size in half—**lets you step up the motor size while reducing control size.** Contacts are easy to reach and remove. All in all, Arrow-Hart Magnetic Starters give you more **working advantages** than any other controls on the market. Find out for yourself.

WRITE FOR FREE BOOKLET

Fully illustrated booklet complete with design and operating features, dimensions, ratings, catalog and parts numbers, etc., covering the complete "RA" line — Sizes 0-1-2-3-4 — yours on request.

ARROW-HART & HEGEMAN (CANADA) LIMITED

INDUSTRY ST., TORONTO 15, ONT. TELEPHONE RO. 2-1101

Representatives: COCHRANE STEPHENSON (Western) Ltd., Winnipeg, Calgary, Edmonton, Vancouver; GEORGE C. ROBINSON, Saint John, N.B. C-5304

File

New booklets and books written for you

A NEW 24-PAGE illustrated color catalogue describing a wide variety of special machine tools with automation is now available from **Snyder Tool & Engineering Company.**

Past, present and future automation concepts for special machine tools are described from both engineering and application points of view in the new catalogue. Methods of selecting economical automated special machines are described. Two pages of the catalogue are devoted to a glossary of automation words and phrases.

Described and illustrated are twenty new automated transfer-type, line-index, trunnion-type and rotary-index special machine tools; all performing a variety of metal working operations including drilling, tapping, milling, centring, boring, facing, reaming and balance milling as well as related production operations such as automatic inspection and rejection, air testing, assembly and marking. The company's method of using standardized components is also carefully illustrated.

The company's three plants are illustrated in the catalogue as well as the engineering department, expanded production facilities. Sales representatives and service facilities are dealt with also in this catalogue. (205)

• • •

OPERATING ADVANTAGES OF "VARI-PITCH" speed changers are described in a new bulletin entitled "Textrope Drive Speed Changers" released by **Canadian Allis-Chalmers.**

Available in 12 sizes from 1 to 75 hp with output speeds ranging up to 2,900 rpm, "Vari-Pitch" speed changers operate in either vertical or horizontal position. They can be made suitable for reversing service with the addition of a simple, low-cost tension stabilizer.

The bulletin includes arrangement diagrams, a selection table showing recommended unit size for standard motors, and a speed range table of "Vari-Pitch" speed changers. (206)

• • •

A BULLETIN COVERING the complete line of Roto-Flo "chipless machining" machines for cold-forming of toothed parts is now available from **Michigan Tool Company.** The Bulletin (No. RF-55) in addition to covering the three standard sizes of machines now available, also shows numerous examples of Roto-Flo machines in action producing toothed parts of various types. Included also are photographs of typical parts formed on Roto-Flo machines and automation equipment for the machines which perform the chipless machining operations. (207)

• • •

THE AVAILABILITY of Bulletin 55A, showing the major stainless steel globe valves in the **Cooper Alloy** line, has just been announced. In addition to schematic drawings of the various valves, the booklet includes a section on design factors. It also contains a table of major stainless alloys, giving their designations and applications. (208)

• • •

DIMENSIONAL STANDARDS for controlled-temperature reservoir and pump units used in casting impregnation program is tabulated in an illustrated bulletin from *Prenco Products, Inc.*

The bulletin describes a typical reservoir and pump unit for holding and pumping Porlox Seal, a new metal oxide type sealing material for impregnating all type castings to eliminate microscopic porosity.

Conventional location of hinged cover, agitator, steam coils, gas flue, pressure gauge, electrical controls, hydraulic controls and fluid pump are shown. The quantity and size of inlets and outlets is also given for each reservoir size. (209)

• • •

A NEW FOUR-PAGE, two-color catalogue (DT-55), which describes the company's line of Colmonoy set diamond tools for specialized grinding wheel dressing operations, is now available from **Diamonds & Tools Incorporated.**

Shown in the new catalogue is a selection of the complete line of dressing tools available. This includes single-point, multiple-cluster, radius, multiple-edge, multiple - layer, impregnated - diamond, cone-point and thread grinder dressers. There is a detailed description of each type of tool, its characteristics and typical fields of application.

Also discussed in the new catalogue is the line of Colmonoy castings for use as special wear-resistant machine components. Lathe and grinder centres and centreless grinder blades cast of Colmonoy are illustrated and described in detail.

Part of the data presented is a diamond tool selection table which lists the recommended diamond size (in average carat) to use with 10 standard grinder wheel sizes. Also included are recommendations on selection of diamond quality for different types of wheel and other information of importance to the user of grinders and grinder wheels.

The new catalogue also explains the advantages of using Colmonoy as the setting material and presents a brief description of diamond setting process. (210)

Book Department

Metallurgical Dictionary

This book by **J. G. Henderson,** Consulting Mechanical and Materials Engineer, was written to fill the need for a comprehensive dictionary covering the broad field of metallurgy and its associated fields.

The aim was not to develop a handbook giving all the physical and mechanical properties, nor to include an almost endless list of proprietary materials and processes.

Rather was it the aim to assemble, in a single volume, definitions of the terms considered essential, both to the professional and to the layman, for an understanding of metallurgical literature. By doing this it should not be necessary to refer to a substantially complete library of metallurgical literature in a piecemeal effort to get similar information.

The book has original definitions of many of the terms, accepted and discussed but not concisely defined in modern metallurgical literature.

The greater part of the book is, however, essentially a compilation and correlation of definitions taken from the vast amount of technical literature written over the years by engineers and scientists.

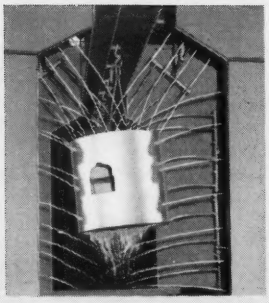
The author's claims, set out above, have been very well met. The book is an excellent buy, for it contains most of the information on general metallurgical terms that the average design engineer is likely to need.

In preparing a dictionary it is, of course, extremely difficult to know where to stop, but omissions which immediately occur to the reviewer are: absolute zero, autoclave, centigrade, Fahrenheit, frozen stress, photoelasticity, secant modulus, silicones, stoichiometry and ultrasonic testing.

There is a spelling mistake on page 123. The series of German magnesium alloys is known as "elektron" and not "electron."

The book is published at $8.50 by Reinhold Publishing Corp.

C-I-L Hi-Bake System gives Beatty Washers long-life finish



Seeking an ever more durable washing machine finish, Beatty Brothers turned to C-I-L for expert advice both on finishing materials and methods of application. C-I-L Paint chemists found the answer in their new 4701-8 Hi-Bake Primer in a specially adapted form for flow-coating application. The final topcoat of CILUX Hi-Bake Enamel results in a gleaming, tough and durable finish characteristic of a C-I-L system.

4701-8 HI-BAKE PRIMER is unusually resistant to moisture and alkali, even in the presence of heat. This outstanding new primer gives Beatty washers enduring protection against rust and corrosion and the usually destructive action of soaps and detergents. Let your C-I-L representative tell you more about 4701-8 Hi-Bake Primer and how you can use it to improve the finishes on your products.

At left, a Beatty washer is flow-coated with C-I-L 4701-8 Hi-Bake Primer.

Photo courtesy of Moore Air Equipment, Ltd., London.

For expert advice on industrial finishing problems, whether they involve a specific problem or operation or a complete production line finishing system for wood or metal, call or write your nearest C-I-L Paints Division District Office. Halifax, Montreal, Toronto, Winnipeg, Regina, Saskatoon, Calgary, Edmonton, Vancouver.

industrial finishes

C-I-L PAINTS

Patents

Some new ideas win protection in Canada

MAGNESIUM-CONTAINING GREY cast iron, patented over five years ago in the United States, was patented in Canada on August 16. The patent, No. 515,688 has been assigned to Canadian Nickel Products Limited of Toronto.

The presence of not more than 0.5% of magnesium is said to increase the tensile strength materially by making the uncombined carbon in the iron take the form of speroidal particles, without heat treatment.

The inventors, all of New Jersey, are Keith D. Millis, Albert P. Gagnebin and Norman B. Pilling.

The same inventors are named in Patent No. 515,689, which covers a heat-treatment for producing malleable iron from white cast iron containing from 0.05% to 0.2% magnesium.

• • •

A PISTOL-LIKE spot-welding tool, with an electrode holder that is advanced when the operator pulls a trigger and retracted automatically to form an arc when the welding current flows is covered by Canadian Patent 515,656 issued on August 16 to Air Reduction Company, Incorporated, of New York.

According to the patent, which names Nelson E. Anderson of Berkely Heights, New Jersey, as the inventor, the electrode holder is held in the advanced position by a latch that is released by an electromagnet when the current flows. This allows the electrode holder to be drawn back from the work by a spring, thus producing a welding arc between the electrode and the work.

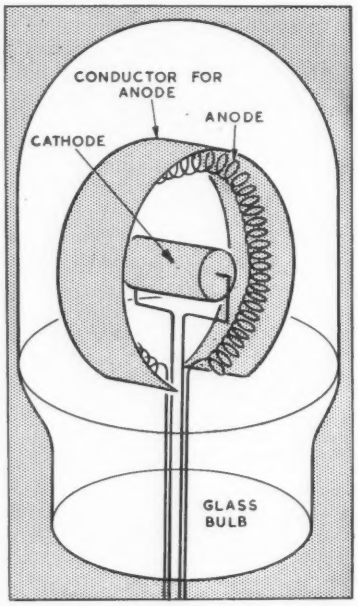
• • •

A TUBULAR CHAIR frame invented by Horace Wilcox of Toronto was patented on August 2, 1955. As described in Patent No. 515,159, it has one part in the shape of an inverted letter U to form the back and legs and two front legs with horizontal extensions to support the seat. The ends of the extensions join the back legs at seat height, and are bent to meet in the centre of the seat where they are welded together to form seat support in the shape of an X.

• • •

THIS IMPROVED MAGNETRON is covered by Canadian Patent No. 515,072 by N. V. Philips Gloeilampenfabrieken of Holland. Relatively inexpensive to manufacture, it has a cylindrical cathode encircled by an anode in the form of a helix of fine wire or thin water cooled tubing.

According to the patent, which was issued on July 26, 1955, the turns of the helix may be connected by a conductor on the side of the helix that is farther from the cathode. In this case the turns of the helix are made equal to a half-wave



DESIGN ENGINEERING PICTURE

length of the generated oscillations so that high frequency voltage of the points connected by the conductor is zero.

The natural frequency of the magnetron varies with the dimensions of the helix, so the frequency may be controlled by varying its temperature. The inventor: Jan Verweel of Eindhoven, Holland.

• • •

A NOVEL RECTIFYING or point contact for a semi-conductor diode, that is rigid enough to maintain its operating characteristics despite shock and vibration, has been patented by Westinghouse Electric Corporation.

The point contact is produced by a column of mercury in a tapered glass tube, which is mounted rigidly with one end resting on the diode. This end of the tube is ground flat and the column of mercury in the bore of the tube is forced against the surface of the diode by a conductive rod above the mercury in the bore, that acts as a piston and also carries current.

The Westinghouse Canadian Patent 513,537, which was issued on June 7, names Daniel R. Muss of Pasadena and Lloyd P. Hunter of Poughkeepsie as the inventors.

• • •

A SIMPLE METHOD for cleaning core sand from the inside of the hollow steel castings is the subject of Canadian Patent 515,669 issued August 10, 1955 to American Steel Foundries of Chicago.

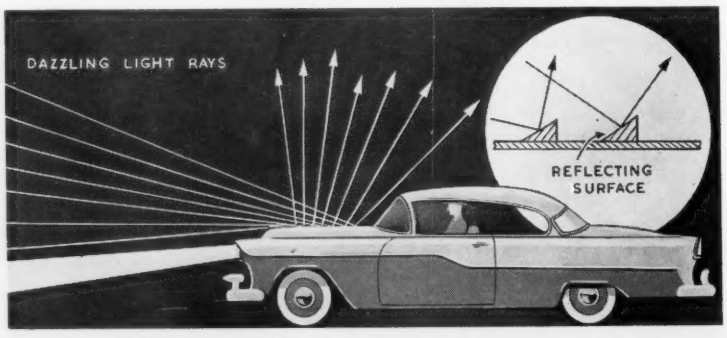
The castings are removed from the mold at above 600°F. Before they cool below this temperature they are submersed in water, and the steam produced by the heat of the casting blasts the sand from its interior. The method was invented by Alfred Walcher, Illinois.

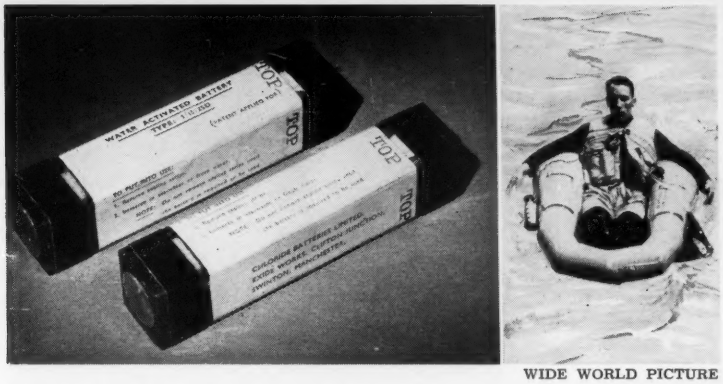
• • •

AUTOMOBILE DRIVERS are said to be protected from hood-reflected glare from the sun or approaching headlights by an invention of Charles H. Van Schaack of Sandpoint, Idaho, covered by Canadian Patent No. 516,056, issued August 30, 1955.

As pictured on this page, the hood surface is made up of light-reflecting ribs or serrations that are wedge-shaped in cross-section and run across the hood from side to side. Each rib has a vertical rear surface facing the driver, and a front surface sloping downwardly. The sloping surfaces reflect the glare away from the driver's eyes.

DESIGN ENGINEERING PICTURE





WIDE WORLD PICTURE

Batteries, left, power torch, light way for rescue, when airman is down on sea.

Water-Battery Energizes Rescue Torch

THE IMPETUS GIVEN to industrial research by the war and later by economic and international difficulties has shown up in storage battery engineering by a stream of important technical advances. One of the most interesting is the recent utilization by Chloride Batteries Ltd., Swinton, England, of a novel electrochemical principle in the design of cell units for "one shot" and emergency applications.

The original problem was to find an alternative to the water-operated calcium flare once used with lifesaving apparatus at sea. Now banned completely by international regulations, these flares were often dangerous as petroleum or fuel oil might be floating on the water.

The solution came with a special water-activated battery which now lights small electric lamps on life-jackets, floats and rafts to aid rescue workers when a ship or aircraft is lost at sea after dark.

Such a battery had to be small, light and unfailingly reliable even after years of idleness in all climates, which ruled out the use of dry batteries. The new water-activated units achieved this combination of virtues so successfully that they have now been developed for many other jobs.

In the battery special dry-charged plates of cuprous chloride and magnesium housed in a perforated or open-ended container designed to suit the cell's use remain completely inert, protected from moisture by sealing tape. In an emergency, the tape is ripped off. As soon as the plates come into contact with either salt or fresh water the battery is charged. Once begun, the discharge then continues until the capacity is exhausted.

A battery of this type has outstanding advantages for "one shot" emergencies. It can be used for high discharge rates for short periods, or for low-rate work over longer periods. In either case it has an outstandingly high performance for its weight and volume. Protected from moisture, it remains completely inert under widely varying temperatures and humidities for an unlimited period. The unit may be designed to function totally immersed in water during discharge—as in the case of flares or life-jacket lights, or after an initial wetting when sufficient water is absorbed to charge it.

A number of water-activated batteries of different sizes and capacities have been developed. Most of them employ cuprous chloride and magnesium electrodes. The smallest works on a slightly different principle with lead peroxide and magnesium electrodes, and is designed to replace the candles once carried by meteorological balloons. Weighing less than half an ounce complete with bulb, it is simply dipped in water and attached to the balloon after which the light will burn for at least 45 minutes.

Two intermediate sizes in the cuprous chloride-magnesium category have been produced for Mae Wests and other air/sea rescue equipment. Sewn into the life-jacket, the battery illuminates a 1.5 volt bulb consuming 0.24 w mounted on the shoulder. The smaller of the two, weighing only 2¼ ounces in its experimental container, will burn for 12 hours and the larger, weighing 4 ounces, for 24 hours.

The fourth and largest of the water-activated batteries in the commercial range, intended for life-saving rafts and floats, will illuminate a 2.5 volt, 2 w bulb for at least 24 hours. ★

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Advertising index — November

Editorial

Ten Dollars Each For Reassuring News 'Shorts'

CANADIANS ARE KNOWN to be modest people. Could it be that with some of our businessmen and technicians this modesty has gone too far?

Two weeks ago, a Canadian found himself riding in a New York elevator with an American associate who gave a judgment on Canadian character. "You know," he said admiringly, "you're just like us. But quieter!"

There is nothing wrong with this. Perhaps there is a great deal right with it—it can hardly be an accident that modesty has so long been listed as a virtue.

But there is the other thing — false modesty. There is some of this in Canada too; it is a trait that does nothing but harm.

Design Engineering has probed industry for news of original design work. By doing so, much valuable material which would otherwise never have been recorded has been found and featured.

For although it is true that too little development work is going on in Canada, it is also true that some is—as **Design Engineering's** pages have shown. But industry is slow to come forward with details. If this is modesty, be sure it is a false brand!

Progress need not always come wearing seven-league boots. For every super-scale scheme that wins broad publicity, there are many little ones (or little developments coming from big ones) to show that our industries are thinking soundly—and afresh. It is many small projects going forward in the hands of wise men who know this country and its special needs that will take us to prominence among the world's industrial nations the fastest way.

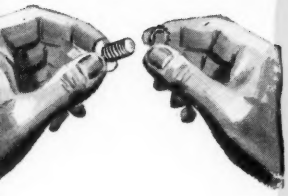
The first wheel is thought to have been a log used by a bright but primitive man; perhaps it is one of the biggest inventions ever. But how simple! Then, Archimedes of Syracuse worked out the theories of leverage: "Give me a lever long enough and a fulcrum strong enough—and single-handed I can move the world," he said. And in a way, with a simple stick and stone, he did.

There is no doubt that Canadians are as inventive as any other nation. It is admitted by most authorities, that many of our production methods for instance are superior to those in the U. S. where economies are less important. And it is safe to assume that our inventiveness goes further than this.

Design Engineering is anxious for news of the less dramatic ideas now improving Canadian products. Readers are invited to send about 200 words to the editors describing informally, any in-the-shop or on-the-drawing board achievements that they have seen their own or other Canadian companies perform.

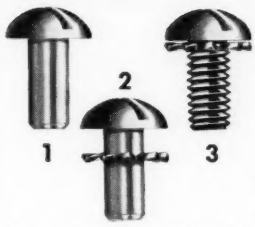
Suitable anecdotes will be published under the heading of **"We Did This."** For every one accepted, **$10** will be paid. And, more important to the nation, evidence of our industrial know-how will stand for ever on the record.

Why SEMS-by-SHAKEPROOF reduce assembly costs!



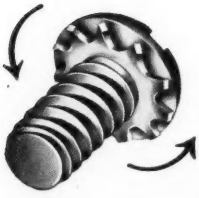
Putting lock washers on screws by hand is costly and time consuming.

With pre-assembled SEMS-by-SHAKEPROOF two parts are handled as one.



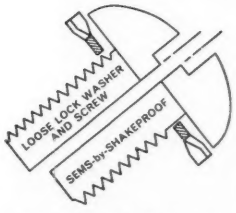
The lock washer is mechanically pre-assembled on the screw —held on by the rolled threads.

Lock washers can't drop off, can't be wasted or "forgotten."



The lock washers on SEMS-by-SHAKEPROOF always rotate freely...

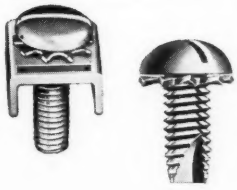
Multiple, tapered-twisted teeth give positive mechanical locking action.



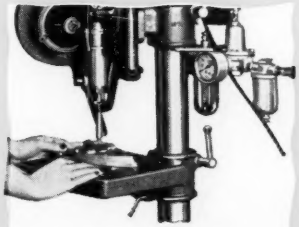
Locking teeth fit closer under the screw head for maximum locking power.

You get the best protection against vibration loosening with SEMS-by-SHAKEPROOF.

Shakeproof's complete line of standards will meet nearly every assembly need.



Specials and multiple-piece units make the range of application unlimited.



One-piece SEMS -by-SHAKEPROOF can be hopper fed for automation!

Eliminate unnecessary handling. SEMS-by-SHAKEPROOF will save time, reduce costs!

Free Sample Kit

Now . . . make your own tests! See for yourself how SEMS-by-SHAKEPROOF can save money in the assembly of your product. Write for your free sample kit today!

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WORLD'S BROADEST LINE OF MASS-ASSEMBLY FASTENINGS

How TIMKEN bearings give Richards-Wilcox cranes a smooth ride, reduce manufacturing costs

TO give this underrunning single-bridge crane a smooth ride and keep it on the go, Richards-Wilcox Canadian Company, Limited, uses 32 Timken tapered roller bearings in the crane end truck wheels.

This smoother operation is possible because Timken bearings virtually eliminate friction. One reason: they're designed by geometrical law to have true rolling motion. And they're accurately manufactured to deliver the low friction this design makes possible.

Cranes like this Richards-Wilcox operate smoothly under heavy working conditions because they have the extra load-carrying capacity provided by Timken bearings. This is the result of full line contact between rollers and races. And since they carry both radial and thrust loads, making thrust devices unnecessary, Timken bearings need less space, allow more compact designs that result in lower manufacturing costs.

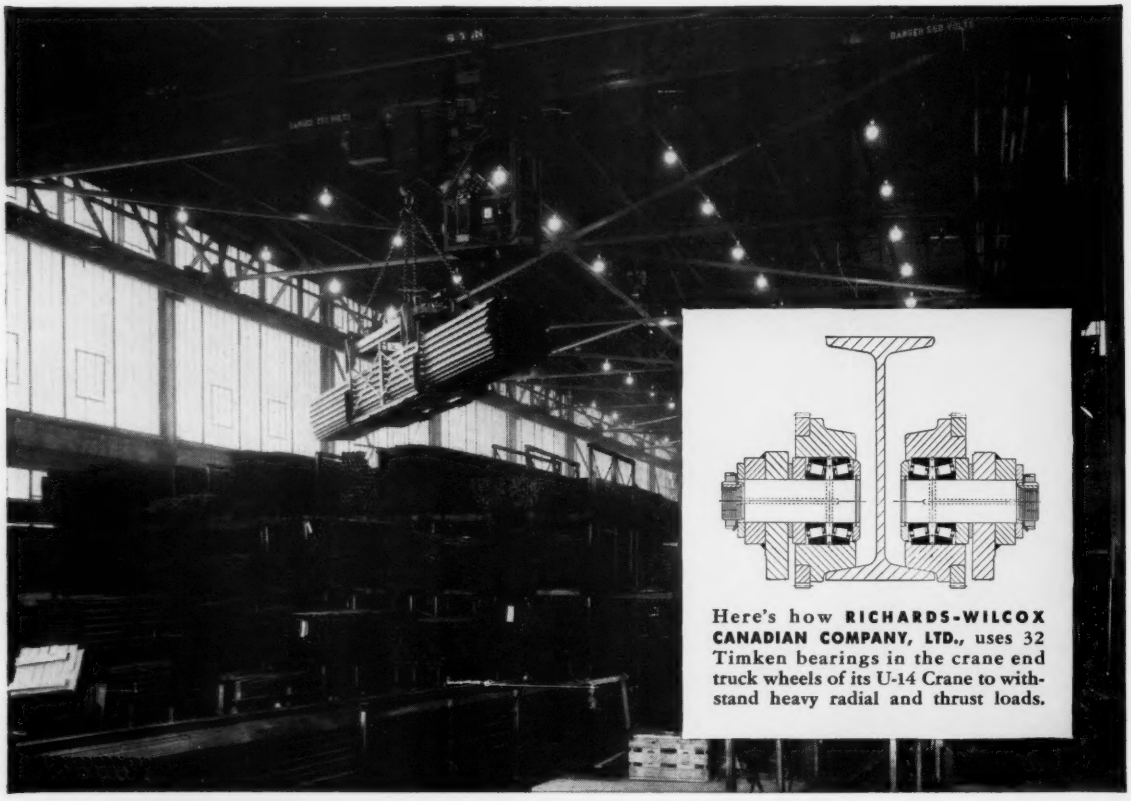
Because Timken bearings hold housings and shafts concentric, closures are more effective. Dirt stays out—lubricant stays in. And maintenance and lubrication costs are held to a minimum.

To make sure bearing quality is controlled every step of the way, we make our own steel. And we make it nickel-rich for superior toughness.

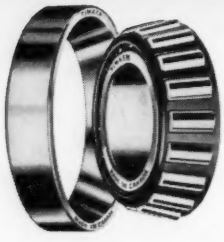
Whether you build or buy equipment, you can have all these advantages if you specify Timken bearings. Look for the trade-mark "Timken", stamped on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. **CANADIAN PLANT:** St. Thomas, Ontario. Cable address: "TIMROSCO".

TIMKEN BEARING EQUIPPED

This symbol on a product means its bearings are the best.



Here's how **RICHARDS-WILCOX CANADIAN COMPANY, LTD.,** uses 32 Timken bearings in the crane end truck wheels of its U-14 Crane to withstand heavy radial and thrust loads.



TIMKEN *Made in* CANADA

TRADE-MARK REG. IN CANADA AND U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

FOR CANADIAN INDUSTRY

NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ⊞ AND THRUST ⊞ LOADS OR ANY COMBINATION ✳